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THE ELECTRIC LIGHT AND THE COMMISSIONERS OF SEWERS.

A FEW weeks since it was resolved at a meeting of the Commissioners of Sewers to take the necessary steps to supply the City of London with the electric light. This resolution was, however, reversed at the meeting held on Tuesday, the 21st ult.

Before commenting upon this rather extraordinary proceeding, we will proceed to give our readers an extract of the debate which took place, and which may be found very fully reported in the *City Press* of Wednesday, the 22nd ult., and the *Citizen* of the following Saturday.

Mr. Pannell brought up a report of the Streets Committee, submitting the opinion of Mr. Preece, F.R.S., as to laying conductors, &c.

Mr. Moore moved, "That Mr. Remembrancer be instructed to take all necessary steps to enable this Commission to become the undertakers for the supply of electricity under the provisions of the Electric Lighting Act, 1882, to obtain a provisional order under the regulations laid down by the Board of Trade, and to oppose the applications of all other parties." They had for years been smarting under the monopolies of gas and water. Special clauses were inserted in the act for the benefit of the local authorities, and they had now to decide whether they chose to allow six lighting companies to have the authority of lighting the streets of the City for the next 21 years, or whether they chose to take upon themselves the responsibility of applying for a provisional order or licence, and thus retain the authority for 21 years in their own hands. Unless the court came to a decision that day they would be effectually shut out, as the time for giving notice would have passed.

Mr. Boor seconded the motion. If it was difficult for the Corporation to discharge these duties how much more difficult would it be for half-a-dozen or a dozen companies to discharge them? The monopoly which existed among the electric lighting companies was far greater than among the gas companies, because it was in fewer hands. It was really worked in a ring of electricians. In nearly every instance the local authorities had passed resolutions to oppose the applications of the companies, and to try and get provisional orders to keep the power in their own hands.

Mr. Innes rose to move as an amendment, "That whilst the Commission is in favour of electric lighting *in the abstract*, it is advisable to allow all further experiments to be conducted at the risk of the lighting companies, and not at the expense of the ratepayers." *In the abstract*, they were not averse to improvement in regard to the lighting of the City, but at present they were not ready to take the steps suggested. They did not oppose improvements in lighting on their own merits, but they did oppose supporting a series of unknown experiments.

Mr. Baptie seconded the amendment. He was told the fear of a monopoly was a very important matter here, but he hoped the Commission would not legislate under the fear of monopolies one way or the other.

Mr. Noon said it appeared to him that Mr. Moore had proved his case up to the hilt, and that this Commission was in duty bound to get the right to light the City themselves.

Mr. Pitman had great pleasure in supporting the motion, as he felt it desirable that they should be the undertakers in this matter.

Mr. Stoneham said, although he supported Mr. Moore on the last occasion, that gentleman had gone a little too far in this question. He had hoped the Streets Committee would have brought them up a report as to the price of the lamps and upon various other points which they must enter into before they could become undertakers of the electric lighting of the City. If they began to lay down wires at the end of Fleet Street a man at Aldgate might apply for light, and they must give it him if they were the undertakers for the City. Although no one could be more anxious than himself to see the City well lighted, they must remember that they had a sacred trust, and ought carefully to sift the matter before coming to a decision.

Mr. Peebles thought the time had not yet come for the court to undertake with public money the responsibility of storing electric light in the City at the enormous expense which would be incurred. He had always been in the van in advocating the adoption of the electric light, but he did not contemplate that the Commission would take it into their own hands. From an estimate given by Dr. Siemens at the Society of Arts, he calculated that the cost of lighting a square mile of the City would be £708,000, or something like three millions for the whole area; and while they were engaged in putting up the works, such changes would probably take place as to make them think that three millions might as well have been thrown away.

Mr. Pannell said the Streets Committee had come to the conclusion that the electric light was undoubtedly to be the light of the future. Suppose they opposed the companies and got the necessary clauses inserted in their provisional orders for the protection of the City. The companies would then commence street lighting at the public expense with public money, and they might one after the other fail. There would be the survival of the fittest, but at any time it would be competent by Act of Parliament, when the Commission thought fit, to step forward to this fittest company, which had survived with the best and cheapest light, and say, "Now we will acquire it." Other companies might spend all their money in making this grand success, but they were not called upon to refund that or pay interest upon it. Suppose they followed Mr. Moore's suggestion, and applied for a provisional order, what position did they at once stand in with the companies? They would stand aloof, and say, "Pay us our price." He thought it was absurd to suppose they were going now to expend a sum of three quarters of a million or three millions, which in two or three years' time might have been absolutely thrown away.

Mr. Ashby remarked that according to the act they would become contractors, not merely for the supply of the electric light, but of electricity to be delivered in houses for whatever purpose it might be required.

Mr. Johnson thought the act was utterly impossible to be carried out, and next year he believed there would be a universal cry for an amended act. The conditions were a great deal too stringent. Under these circumstances, he must alter his vote on this occasion and oppose the motion.

Mr. Moore said there was so much that was in harmony between his views and the views of those who supported Mr. Pannell that without care they could not say where the line of distinction lay. In June, when he introduced the subject, he did not ask the Streets Committee to consider the matter hastily. He impressed upon them, in fact, everything which had been brought against his resolution to-day. But their hands were forced. Six electric lighting companies gave them notice that they were about to apply for provisional orders, and they could not wait. It was to-day or never. The question underlying everything was monopoly or no monopoly. He thought the amendment might with every fairness be added to his motion. That which he complained of was that it did not raise a fair issue. The matter had been under discussion four months, and he wished the court to make up its mind. He saw nothing in the act which it would be impossible to carry out, and he asked that those who had supported him would not allow dust to be thrown in their eyes. He asked any man of common sense whether the Government or Board of Trade would insist upon impossible conditions? He saw in the report strong arguments in favour of his resolution. Mr. Preece was asked to reply to certain questions, and was not asked for an opinion on the general subject. He said, "The whole question of the distribution of electricity for lighting purposes is in a very tentative state; sufficient experience has not yet been gained to determine exactly what is required under all circumstances, or even what those circumstances will be, and I think that those corporations who have taken upon themselves to supply electricity have undertaken a responsibility that they have not sufficiently contemplated, and which, with the present state of our knowledge, is extremely difficult to discharge." He had no doubt that a dozen eminent electricians could be found to express opinions diametrically at variance with these conclusions. Messrs. Peek, Frean and Co. informed him that by means of the electric light they effected a saving of about 20 per cent., which included the cost of a separate engine. The lords of the Committee of Council on Education said the cost of the Brush light, including the carbons, was 3s. 10d. per hour, as against 16s. per hour for gas. What was there, he asked, to prevent them introducing the light by degrees, district by district, and then they might ultimately select the best. While Sheffield, Rotherham, and other corporations, had provisional orders he hoped the City, as the largest corporation, would not be left out in the cold.

The amendment of Mr. Innes was put and declared carried.

A division was demanded, the result being: For the amendment, 33; against it, 29; majority, 4.

When put as a substantive motion, there were: For it, 22; against it, 21; majority, 1.

Mr. Alderman Staples moved, "That the Remembrancer be instructed to appear on the application of the companies, and secure clauses protecting the public and private rights of the City."

Mr. Innes seconded the motion, which was agreed to.

The minutes of the last ordinary court having been read,

Mr. Stoneham gave notice of the following motion: "That, considering the vast interests at stake, a select committee be appointed to inquire into the necessary steps to be taken to enable this Commission to become the undertakers for the supply of electricity to the whole or any district of the City of London, under the provisions of the Electric Lighting Act, 1882, and report forthwith to this Commission; and in the meantime Mr. Remembrancer be instructed to oppose all other applications."

We think that almost everybody will be agreed that the amendment (in name only) proposed by Mr. Innes might have been tacked on to the motion of Mr. Moore. In common with a contemporary, we ask what does the former gentleman mean by electric lighting *in the abstract?* We can only imagine that he belongs to that class of people who are in favour of using the electric light as long as it is paid for by somebody else.

The decision arrived at, however, does not even now appear likely to be the final one, for we observe that notice to rescind this resolution has already been given in at the Sewers' Office. Such being the case, it is evidently useless to discuss the matter, but it would be interesting to know what motive influenced the present result. Perhaps the whole affair was looked upon as a choice of evils; on the one side an expenditure of money which might or might not be exceedingly heavy, and on the other the danger of another monopoly. We have no wish to suggest that interests, personal or otherwise, which possibly crop up amongst those in debate may have led to the determination of the Commissioners of Sewers' majority, and it may therefore be that the report of Mr. W. H. Preece, F.R.S., weighed somewhat heavily in the scale of Mr. Moore's opponents. Apparently Mr. Preece has gratuitously given more advice than that asked for, and this has evidently influenced some of those who might otherwise have voted for the motion under debate. The past President of the Society of Telegraph Engineers and of Electricians has always been—unless we are much mistaken—an opponent of electric lighting, especially to the arc system, in a passive sort of way. Towards an incandescence method we hear he has reason to be more friendly disposed. It appears to us to be an ill-advised and egotistical proceeding on Mr. Preece's part to depart from the questions asked of him for the purpose of indirectly throwing cold water on the efforts of those who view the electric light with favour. At least this is the light in which we view the concluding remarks contained in the report, which will be found in our other columns. We shall look forward with increasing interest to the reconsideration of this matter, for although the official time for sending in applications to the Board of Trade has passed, the board is still willing to entertain future applications, and we shall, therefore, probably yet see the Commission become the undertaker for the supply of electricity in the City of London.

OBITUARY.—We learn with regret that Mr. Drury, Chief Mechanician to the General Post-office, expired early this week. He was well known in the Postal Telegraph Service, and his demise will be a great loss to the department he had served for so many years. He was much respected by those who knew him well.

THE "FERRANTI" ALTERNATING CURRENT MACHINE.

WE are at last enabled to present to our readers a description and illustrations of this much talked of invention. It is well known that Sir William Thomson's name was connected with that of Mr. Ferranti as a joint inventor of the machine, and we purpose, first of all, to give an extract from the former eminent electrician's patent, dated December 26th, 1881, and numbered 5668. After describing various forms of dynamo-electric machines, the inventor goes on to say:—

"Another form of dynamo is shown in part at figs. 1 and 2. This consists of a wooden disc, A, with projecting

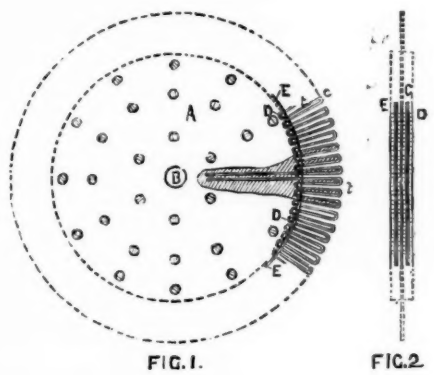


FIG. 1. FIG. 2.

wooden teeth, *t*, the whole mounted on an axle, B. A flat slip of copper or a square copper wire, C, bent round the teeth, *t*, to the form shown in the drawing, is fastened to the edge of the disc, A, in the manner hereinafter described, and having its two ends passing in towards the centre of the disc to two suitably arranged contact-pieces. The fastening of the conductor, C, is effected as follows: a sufficient number of notches are cut across the edge of the disc, A, to receive the bends of the conductor, C. The conductor, C, being placed in position, wooden pins, D, are then laid in the notches over the conductor, the pins being of such a

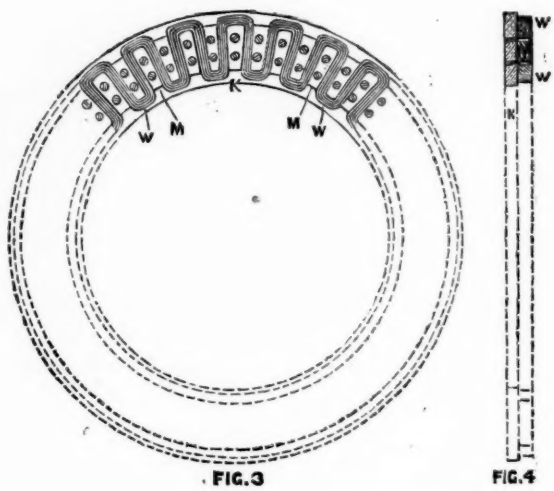


FIG. 3 FIG. 4

diameter as to project a little beyond the surface of each side of the disc, A. A stout steel wire, E, is then passed two or three times round the edge of the disc, A, on each side of the square wire, C, and so serves the purpose of pressing each wooden pin into its notch, in that way binding the conductor wire firmly to the edge of the disc, with strength enough to resist centrifugal force.

"When greater electromotive force and less resistance are required, the zig-zag may be made multiple of slip copper, as

hereinafter described, with reference to the group of electro-magnets for this form of dynamo at figs. 3 and 4.

"The hereinbefore-mentioned form of dynamo, as represented at figs. 1 and 2, is well adapted for an alternating current machine; the magnetic fields by which the radial

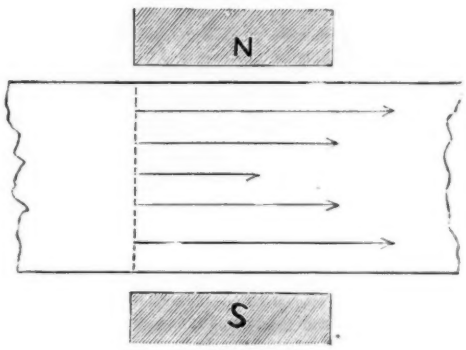


FIG. A.

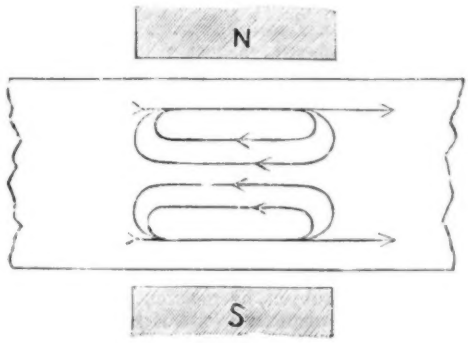


FIG. B.

portions of the moving conductor are excited being produced either by fixed steel magnets or by fixed electro-magnets, giving alternate areas of red and blue (true south and true north) magnetic polarity on the two sides of the space in which the radial bars move.

"When electro-magnets are used, I arrange them as shown in part at figs. 3 and 4, so that each straight radial part of the conductor, W, serves to excite the soft iron of two contiguous electro-magnets, M, M.

"A flat circular cast-iron ring, K, is provided, having suitably shaped pieces of soft iron, M, M, bolted or screwed, as shown, on its surface. A flat strip of sheet copper, or a considerable number of mutually insulated flat strips are then bent, so as to pass round these soft iron blocks, M, M, in a zig-zag manner, as shown in figs. 3 and 4 (which is a transverse section of fig. 3), and with the breadths of the strips, W, everywhere perpendicular to the surface of the ring, K. A sufficient number of such copper strips, W, insulated from each other, and from the iron blocks, M, M, and ring, K, and joined in series, form the exciting conductor. In this form of dynamo, a separate exciter must be used, and any convenient form of brush may be adopted."

From this illustrated extract, our readers will be able to judge for themselves as to what extent Mr. Ferranti has been forestalled by Sir William Thomson, so far as priority of invention is concerned.

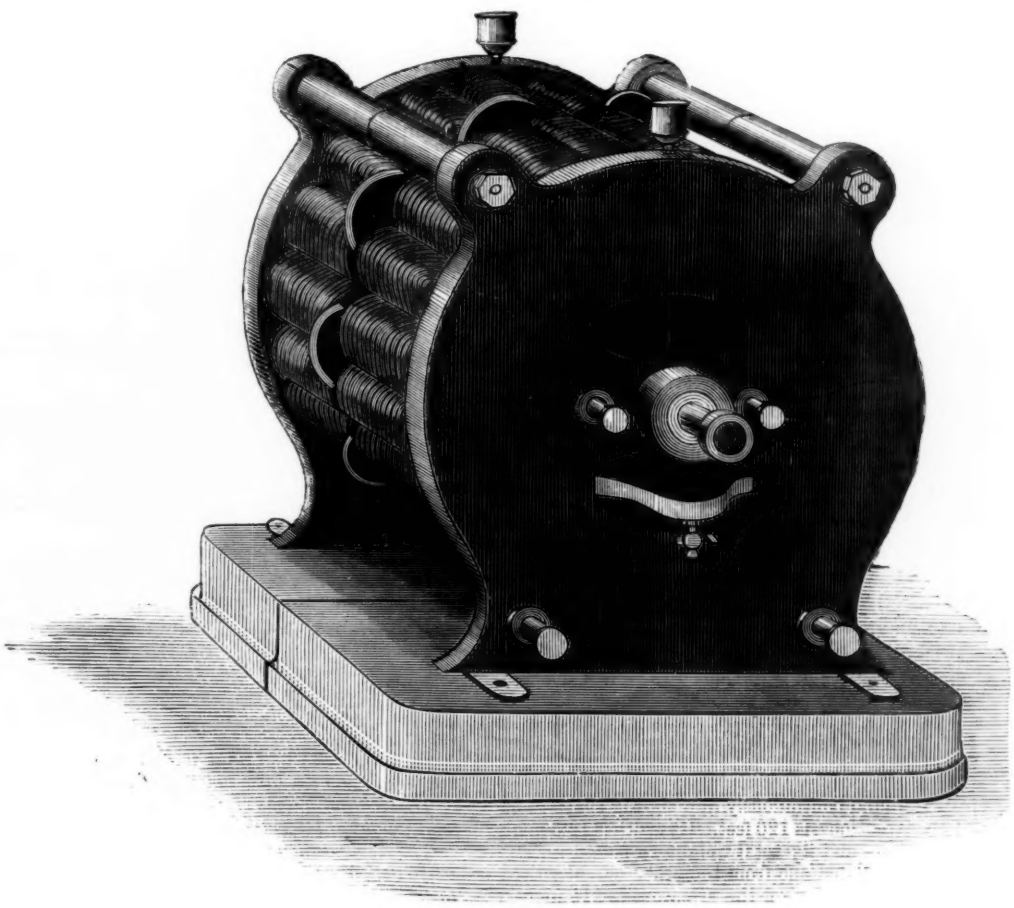


FIG. 5.

Some of our contemporaries, when describing the Gordon alternating current machine recently, spoke of the use of a ribbon of copper in these terms:—

"The use of a rod or ribbon for winding the coils instead of wire has recently been heard of a good deal. Mr. Gordon has experimented in this direction, and states that the effect of using a ribbon of such a width that the portion of its

diameter which is furthest from the magnet poles is in a field of sensibly less intensity than the portion near to them, was, that only a very small electromotive force was produced at the ends of the ribbon, an enormous quantity of horse-power was absorbed, and in two or three minutes clouds of smoke poured out of the machine, owing to the burning of the insulator. The reason of this is easily understood by looking at the figures, which represent a ribbon or rod of copper passing between magnet poles, the direction of motion being supposed perpendicular to the plane of the paper. In fig. A, the directions and lengths of the arrows represent respectively the directions and magnitudes of the electromotive force produced, while fig. B shows the direction of the current due to them. Thus we see that only a small portion of the current arrives at the ends of the ribbon, and that most of it is wasted in forming 'eddies' in the width of the copper."

We are not quite sure of the precise width of the ribbon used by Mr. Gordon, but we believe, that when speaking with him on the subject, he mentioned three and a half inches. However, whatever it might have been, we could not conclude that the heating effect as described above was due to local "eddies," but rather to some short-circuiting or other cause overlooked at the time. Why Mr. Gordon chooses to employ a ribbon of such a width as to place its middle in such a position that it passed through a magnetic field of sensibly less intensity than did its outside edges, is a matter which we do not pretend to understand. One cannot help thinking, however, that these remarks were aimed at the construction of the machine we shall now describe. Fig. 5 is a general view of the "Ferranti" dynamo-electric machine, and in a few words it may be described as being made up of a cast-iron frame in two pieces, each carrying 16 electro-magnets arranged in a circle, with their poles within a short distance of each other, and having between them a revolving zig-zag shaped ring of copper ribbon composed of 12 layers. The two ends of this continuous ribbon are connected, one to a ring attached direct to the axle supporting the armature, and the other to a second ring on the axle, but insulated from it. Two rubbers convey the alternating currents to two terminals, shown on the outside framework of the machine. The small pulley at the end of the axle is for the purpose of connecting the machine with a speed indicator. The electro-magnets are fed from a separate source, in this instance from a small Siemens machine of the D^6 type.

The armature is partially shown in fig. 6 as it appears with

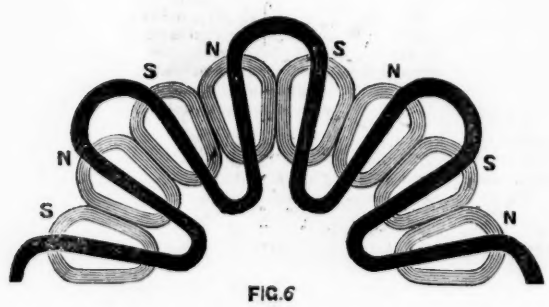


FIG. 6

one side of the machine taken away. The length of the copper ribbon, which is wound continuously in a zig-zag shape so as to produce 12 convolutions, is 120 feet. Its width is 12·5 mm., and thickness 2 mm., and its total weight 18 pounds. The convolutions are insulated one from the other by vulcanised fibre. The outside diameter of the armature is 21½ inches, and the mean diameter 15 inches. Its resistance is only ·0265 ohms. From these figures our readers may calculate the mean, or periphery, speed of the armature which, at the time of our first inspection of the machine, was running at 1900 revolutions per minute.

We are not able to give the mechanical details of the manner in which the armature is attached to the axle of the machine, as we understand publication of this portion of the apparatus would endanger some of the foreign patents. Our readers of a mechanical turn of mind could, however, doubtless suggest many methods of accomplishing such an object, and we therefore fail to see the necessity for keeping back such details from the scientific press, whose endeavour is usually to present a *complete* description of any apparatus its representatives are invited to *publicly* inspect.

The electro-magnets are alternately north and south, and their complete dimensions are as follows: length, about 6 inches; depth, about 4½ inches, and diameter at widest part, 3¼ inches.

The core of each magnet is wedge-shaped with rounded ends.

The wire on each electro-magnet is 3·5 mm. in diameter, and consists of but four layers, weighing about 8½ lbs., and the total resistance of all the 32 electro-magnets connected up in series is 2½ ohms. The two lower terminals on the machine represent their ends.

The small Siemens' machine used for exciting these electro-magnets produces in them a current of 21½ ampères. Their poles are within ⅜ of an inch of each other, so that a very intense magnetic field is the result.

The height of the machine is 25 inches, and its base measures 24 × 22 inches. Mr. Ferranti informs us that its total weight is only 11¾ cwt.

This small and very compact apparatus, with the aid of the Siemens' "exciter" (weighing about 2 cwt.), was producing the current which kept 300 Swan incandescent lamps in action at a *stated* luminosity of 20 candle-power each. The lamps were arranged between the main conductors—which, by the way, were naked copper wires of one quarter inch in thickness—three in series, so that an electromotive force of about 150 to 160 volts should be required for each set of three lamps, and a current strength of about 1·4 ampères. We are informed that in the absence of any but approximate measurements, the machine may be considered as having an electromotive force, or difference of potential between its terminals, of 125 volts.

It will be quite understood that these figures refer solely to this particular form of machine, as any difference in its construction may be made to produce higher or lower electromotive force, and, therefore, more or less current. According to the table of tests on Swan lamps which we published at the time of our description of Gordon's machine, a lamp of this kind, when at a luminosity of 20 candle-power, showed a difference of potential of 52 volts, and the current strength was 1·4 ampères. The resistance of each lamp would then be about 40, and three of them in series 120 ohms. One hundred sets of three would give an external resistance of 1·2 ohms, irrespective of the conductors. Therefore, this would show that either the electromotive force of the "Ferranti" machine as given to us is too low, or that the Swan lamps shown in connection with it do not give a light of 20 candle-power each; or again it may be that the lamps employed are of a different type to those used by Mr. Gordon.

But these are matters of little importance now and can be put aside pending the results of trustworthy tests.

We are not aware that there is claimed for this machine much greater efficiency for horse-power expended than is obtained from certain other well-known types of dynamo-electric machines, but the following advantages are set forth:—

Its extreme simplicity, and therefore its non-liability to get out of order.

Its small size and light weight in comparison with other machines to do the same amount of work.

The trifling weight of the armature in comparison to the total weight of the machine.

The combination of a perfect mechanical and electrical construction and a high degree of electrical efficiency from the small weight of material employed.

The low price of the machine considering the work accomplished.

Whilst writing the above description of the machine we received every assistance at the hands of Mr. Ferranti. On Monday evening last a large number of gentlemen connected with the press and others scientifically interested in electric lighting met in the Cannon Street Station Arches, Cousen Lane, Dowgate Hill, for the purpose of publicly inspecting the "Ferranti" machine. The number of Swan lamps

in circuit had been increased to a total of 320, and we were officially informed that they are of that type usually employed by Messrs. Siemens Bros. for their installations of the incandescence lamps, viz., lamps requiring a difference of potential of 41 volts, and a current strength of 1·28 ampères to produce a light equal to 18 standard candles. The machine was then said to be producing 160 ampères, with an electromotive force of 125 volts. A considerable difference of opinion seemed to exist amongst those present as to the candle-power of the lamps, but as they were all strung so close together, it is quite impossible to give a fair estimate as to the amount of light produced, although we should be inclined to think that the luminosity was not nearly so high as that stated. We say this not merely from personal observation, but also from a comparison of the following figures given to us with those that have been deduced from many reliable tests. The indicated horse-power of the engine—one of John Fowler's 16 horse-power nominal—when driving both dynamo-electric machines in circuit with 300 lamps and including the interposition of countershafting, was said to be but 25·5, or, in other words, that 12 lamps of 20 candle-power are realised from each indicated horse-power. The engineer-in-charge of the "Ferranti" system informed us that the engine indicated *about* 7 horse-power when driving the countershafting and the machines free.

We leave our readers to make their own calculations and to decide for themselves whether the results said to be given by the "Ferranti" machine are correct.

Are the indications of the horse-power too low, or is the estimated candle-power of the lamps too high? As these are points which will be cleared up by reliable tests, we do not desire that our remarks should be looked upon as hostile to this latest development of dynamo-electric machines. On the contrary, we are extremely pleased with the new machine, and only wish to draw attention to those points in which errors may most readily occur. Mechanical engineers are apparently disagreed as to the advisability or even practicability of constructing such a form of machine with a very large armature owing to the difficulty which would probably be experienced in firmly securing the armature against the effects of centrifugal force, but we have sufficient confidence in the ability of our engineers to believe that no serious obstacle will arise in this respect.

The differences existing between the two latest dynamo-electric machines publicly exhibited is very striking.

The "Gordon" weighs, complete, 18 tons, its electro-magnets are excited by two "Bürgin" machines of considerable size, and it has been seen in operation with 1,300 Swan lamps in circuit of 20 (stated) candle-power each. It is constructed to actuate from 5,000 to 7,000 similar lamps with adequate driving-power. The wheel of revolving electro-magnets weighs 7 tons, and its diameter is 8 feet 9 inches. The weight of wire on the machine is 5,376 lbs.

Its speed at its maximum would be about 200 revolutions per minute, and it is coupled direct with the steam-engine.

The "Ferranti" weighs, complete, 11¾ cwt. Its electro-magnets are excited by a small Siemens machine, weighing about 2 cwt., and it has been publicly shown in connection with 320 lamps of a similar character to those above.

The revolving armature is 25 inches in diameter at its extremities, and its weight is 18 lbs.

The weight of wire on the machine is 290 lbs.

Its speed is about 1,900 to 2,000 revolutions per minute, and it is driven by belting from a pulley.

From these figures interesting comparisons may be made as to the relative advantages possessed by the two machines, although the "Ferranti" is placed at a disadvantage by reason of its very smallness.

In conclusion we wish the inventors and the Hammond Company, which is responsible for the introduction of the machine, every success with the future development of this most simple, compact, and efficient apparatus; and we shall be much surprised if the present dulness pervading the whole of the electric lighting business be not greatly brightened, and the prospects of lighting by incandescence in particular enormously advanced by the introduction of the "Ferranti" dynamo-electric machine.

A "Brush" 40-arc light machine, weighing two tons, was shown side by side with the little "Ferranti," and it was labelled to the effect that it was capable of producing 160 incandescence lamps. We trust, however, that no visitor was allowed to go away with the impression that it was constructed for such a purpose.

The advantages already enumerated are not, we think, exaggerated, and one of the great drawbacks hitherto existing, viz., the high prices of the machines, seems to be in a fair way of being reckoned amongst the things of the past. A point which must not be overlooked is the long time the armature can be kept running without any dangerous heating.

It is said that the machine we have here described might, with a trifling alteration, be made to give 500 lights, and a machine to give 2,000 lights, which is in course of construction, and which will be ready to be supplied at an early date, is only very slightly larger.

The large sizes which the company have in hand, are said to be capable of yielding 1,000, 5,000, 10,000, and 25,000 lights respectively.

The Hammond Electric Light and Power Company, Limited, who are the sole agents in England for the new machine, are already in communication with leading corporations throughout the country, in reference to an expenditure of capital under the provision of the Electric Lighting Act.

MR. PREECE'S REPORT TO THE COMMISSIONERS OF SEWERS.

GENTLEMEN,—Having heard from your engineer that you were desirous to receive my opinion on two important questions affecting electric lighting in the City of London, and after having had various interviews with Colonel Haywood on the matter, I have much pleasure in reporting as follows:—Question I.—Will it be practicable to lay in the same tube the conductors of different companies, for lighting by different systems of electricity, without the conductors so laid interfering injuriously with each other? Answer.—The answer to this question involves both a practical and an electrical point of view. Firstly.—From a practical point of view, there is no difficulty whatever in laying down a pipe containing separate conductors for different companies, and no trouble whatever would be experienced so long as the wires remained sound and good, and were undisturbed, but the moment failures occurred from defects in the insulation of the conductor, or from accident, or when additions were needed through the development of a system, difficulties of a serious nature would arise. Then the practicability becomes simply a question of dimensions. (a) If the tube be an iron pipe of 3 in. or 4 in. diameter, such as those used for telegraphic purposes, then it would be impracticable to maintain several independent electric light wires in it, for, as the insulated conductors have to be drawn in and out of the pipes, whenever additions or repairs have to be made, no company would consent to have its perfect conductors disturbed to allow another company to repair its defective ones. Nor under any circumstances could a conductor so placed be moved without there being a considerable liability to damage. All the conductors are insulated, either with gutta-percha, india-rubber, or other substances that are remarkably sensitive to damage when moved. At the present time damage is only prevented by the exercise of great care on the part of those who have acquired great experience, and it is hopeless to expect the exercise of such care on the part of rival companies towards the conductors of their opponents. We all know the tendency that there is on the part of subordinates and workmen to convert their feelings of rivalry into acts of maliciousness; indeed, already one of the great troubles that electric light companies have to meet with is the malicious interference of their conductors by workmen engaged in other concerns. Efforts have been made to introduce conduits, which shall prevent the necessity of drawing-in involved in the use of pipes, by constructing them so that lids or coverings may be lifted off to enable the con-

ductors to be placed in their position or removed. It has even been suggested that the kerbstones should be replaced by iron boxes, in which the wires should be laid; but all these plans have been condemned through the difficulties caused by crossing streets and side openings, by traffic, and by the necessity of protecting insulated wires from the varying changes of weather in this inclement climate. I know of no other practical plan than that of drawing in the conductors into pipes of sufficient size well laid beneath the streets. (b) If we take an iron tube of large dimensions, such as that which was some years ago laid down between St. Martin's-le-Grand and Euston for a projected pneumatic post, and which was about three feet in diameter,* the same objections still apply, though slightly modified; the conductors would, however, be equally liable to injury, either through accident or through wilfulness, whenever occasion arose for their being moved or examined. (c) If, however, we construct a subway large enough for men to circulate through, these objections would cease, for then each company would have its own conductors protected in an iron, lead, slate, or wooden casing, which would easily admit of examination and repair without the necessity for drawing in and drawing out, except for its own operations. Such a system exists in the sewers of Paris, where all electric light companies, telephone companies, and telegraphic systems can be accommodated without interference with each other, and without liability to injury. Such a system exists under the Holborn Viaduct and its approaches, and indeed for electrical purposes the arrangements carried out under the Holborn Viaduct and approaches are far superior to those which exist in Paris, the subways having been specially designed for the reception of pipes. Were the Holborn Viaduct system more extensively adopted throughout the City of London, all difficulties would cease. My opinion, therefore, is that, except in a subway of considerable size, it is impracticable to maintain the conductors of different companies in the same tube. Secondly.—From an electrical point of view I do not anticipate any injurious action from the electrical influence of one electric light conductor upon another conductor employed for the same purpose. If the flow of electricity be steady and uniform, and if the conductor, with its insulated coating, remain perfect, there can be no disturbance. When the flow of electricity is intermittent and alternate in direction, there may be serious disturbance upon telegraphic and telephonic wires, but I should not anticipate injurious disturbance to the electric light currents so long as the conductors remained well insulated. The disturbance caused by these alternate currents is very serious, and it is evident by the simple fact that if a conductor conveying such currents be enclosed in an iron tube, this tube becomes warm through its rapid magnetisation and demagnetisation due to the rapid changes in the electrical influence about the conductor; but this disturbance would not affect the flow of electricity for electric lighting. Hence, though there will be electrical disturbance, I do not think that it need be taken into consideration as affecting conductors employed for electric light purposes. Question II.—If the conductors laid in a district by any one company be discontinued, would they be available for any other company using a different system of electric lighting? Answer.—My reply to this question is, that that depends upon the system. If the conductor were laid for the Brush arc system it would not be available for the Edison incandescent system, whereas, if it were laid for the Edison incandescent system it would be available for the Brush system, though it would be very ill-suited. There are several systems of electric lighting in use, which may broadly be divided into (1) the arc system and (2) the incandescent system; and each system can again be divided into (1a) that which is worked with high tension and (2a) that which is worked with low tension electricity. We may take as a type of an arc system worked with high tension the well-known Brush, while that worked at low tension is represented by the Siemens. Again, the high tension incandescent is illustrated by that preferred by Mr. Swan, while that known as the Edison system is a low tension incandescent system. Now each of these systems, to properly fulfil its purpose and to be worked judiciously and economically, requires a separate and distinct system of conductors, whose weight, insulation, and form, vary according to each particular installation. The arrangement of conductors, to fulfil the requirements of an electric light system, is a very complicated matter indeed. It involves mathematical analysis, abstruse calculation, and great experience and skill to balance the energy expended at the central station with the work done in the streets and houses. I know of no branch of engineering where more forethought is necessary to calculate all the contingencies likely to be met with than a system designed to illuminate a large city like that of London. A conductor conveying electricity is not like a pipe conveying gas or water. The pipe which conveys fluids discharges, without material loss, the fluid put into it; but the conductor conveying electricity only does so at a serious loss of energy. The very fact of conveying electricity means waste. The conductor becomes warmed in consequence, and if the conductor be improperly apportioned to its work it not only involves a considerable waste of power, but it becomes dangerously and injuriously heated. Every system requires its own distribution dependent upon the area to be illuminated, the number of lights, the route of the conductors, and the position of the generating station. The whole question of the distribution of electricity for lighting purposes is in a very tentative state; sufficient experience has not yet been gained to determine exactly what is required under all circumstances, or even what those circumstances will be, and I think that those corporations who have taken upon themselves to supply electricity, have undertaken a responsibility that they have not sufficiently contemplated, and which, with the present state of our knowledge, is extremely difficult to discharge. Hence I say that while there may be cases where the conductors of one company may be available for another company, there cannot be a case where they are properly available unless the two companies employ the same system and utilise the same central station for the generation of their electricity, and for the distribution of their force.

(Signed) W. H. PREECE,

Past President, Society of Telegraph Engineers and of Electricians.

London, *November 2nd*, 1882.

* [This tube was 4 ft. 6 in. by 4 ft.—EDS. ELEC. REV.]

THE ELPHINSTONE-VINCENT DYNAMO-ELECTRIC MACHINE.

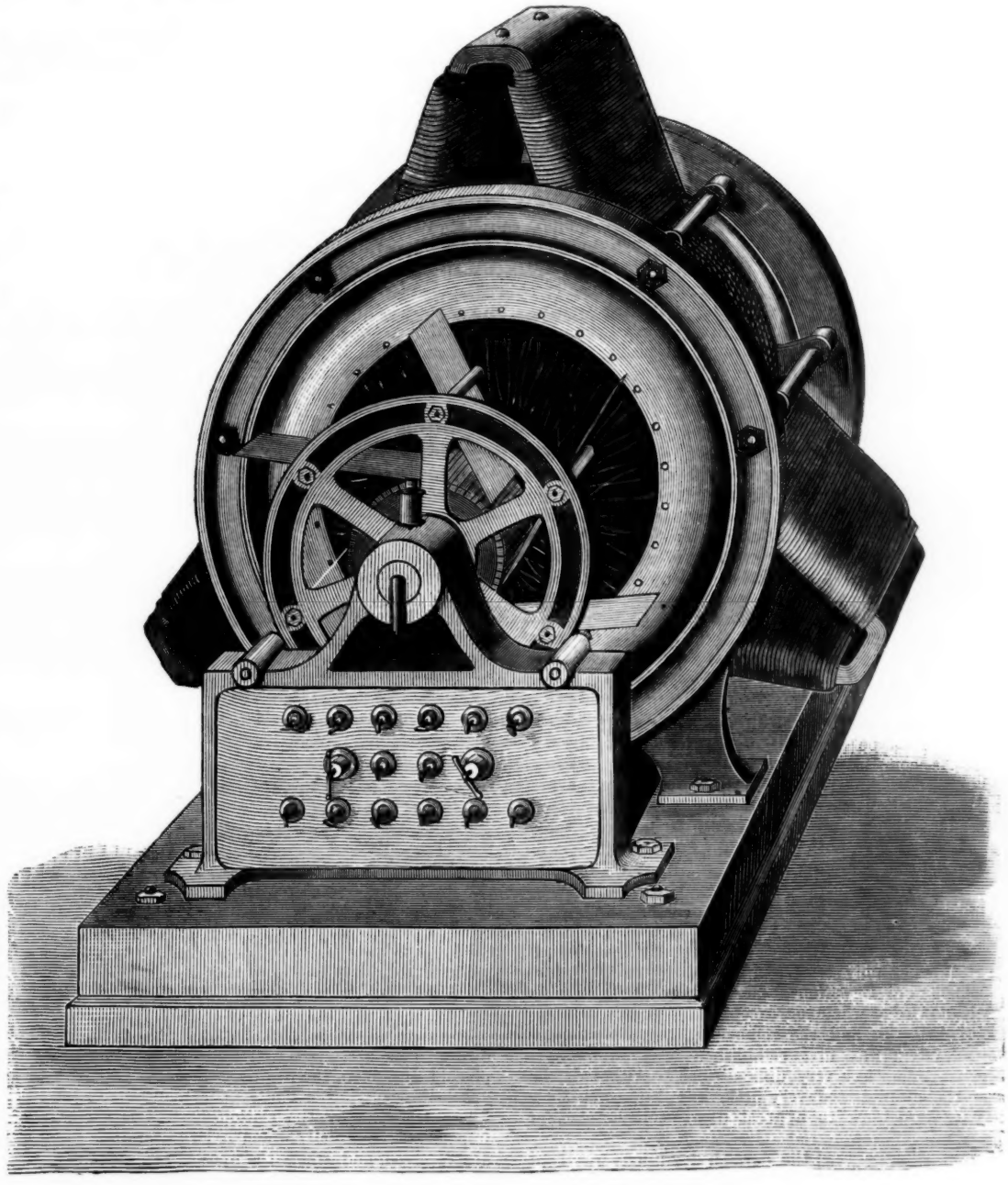
THE accompanying drawing shows a general view of this machine, which has been the subject of several patents. As long since as January, 1879, the above-named gentlemen took out a patent for a machine, which was subsequently improved upon. These improvements formed the subject of another patent, dated July 13th, 1880, and the improved machine was illustrated and described in our "Abstracts of published Specifications" columns, for April 1st, 1881. Various portions of the machine have still further been altered, and we shall refer to the details in a future issue. Several of these dynamo-electric machines have just been constructed, and we understand that their efficiency is very high, but in the absence of any data we can only make this statement with reserve. The machine here illustrated weighs complete about 26 or 27 cwt., and is constructed for working 400 incandescence lamps. It will be seen that three V-shaped electro-magnets surround the armature, there being therefore six poles of N and S alternately. Inside the armature is an iron spindle carrying six internal electro-magnets of similar polarity to those above.

The armature is not coiled with wire as is usually the case, but flat hollow parallelograms of double wire are constructed and laid on the outside surface of the armature drum, which is formed of a kind of *papier-mâché*. These parallelograms of wire are laid all round the drum overlapping each other, and they are firmly bound down with string or any suitable binding.

The ends of the wire coils are connected up with a commutator in all respects similar to that employed in the

Gramme machines. There are six brushes employed, which can all be easily adjusted to the best point of the commutator. The ends of the electro-magnets are brought to the terminals seen on the face of the machine—the inside ones through the spindle—so that any desired coupling may be made. There are several points of novelty in this machine which, however, we shall fully deal with shortly.

The arrangement of the armature drum, its coils, and the electro-magnets forms the chief feature in the machine, for it is by means of this that the external and internal poles of the



electro-magnets are brought very near together, thus forming a magnetic field of great intensity, through which the coils of wire on the surface of the armature drum pass.

Personal.—Alexander Graham Bell, of telephone fame, secured his final papers of naturalisation, as a citizen of the United States, at Washington on November 10th.—*The Operator.*

PROCEEDINGS OF SOCIETIES.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

An ordinary general meeting of this society was held on November 23rd, Lieut.-Col. Webber, R.E., president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of proposed new members read, it was announced that amongst the recent donations to the society was a medallion cast of Œrsted, which had been presented by Mr. Erichsen. Mr. Ladd had also given to the society the original letter of Reis, dated July, 1863, in which his first telephone was described.

The president, having vacated the chair (which was then taken by Mr. W. H. Preece), read a paper entitled, "Notes on the Telegraphs used during the Operations of the Expeditionary Force in Egypt." The work of one of the oldest members of the society, Col. F. Bolton, had not

been placed on record. This gentleman, as early as 1855 and 1857, had turned his attention to telegraphy as applied to military purposes, and in 1861 he had submitted to the Government a complete system. This system had been approved by Col. Shaw, and in 1862 Col. Bolton continued to interest himself in the subject, and read a paper on it at Chatham. In the same year he introduced a portable army telegraph; this was both acoustic and recording, which was a great advantage, since it could be read in the dark. In consequence of the very favourable report which was made on the system, it was fully adopted at the end of 1863. In that year Col. Bolton joined Capt. Coulomb and drew up a number code. Ten years ago Col. Malcolm and Major Webber read a paper before the society on "Military Telegraphy," in which a description was given of what had been done in the subject up to that date. The military telegraph system was then stated as being divisible under four heads, viz., "Permanent," "Semi-permanent," "Field," and "Visual Signalling." At that time Lieut.-Col. Webber suggested that numerical code signalling should be abandoned, and in 1876 this view was generally adopted, but unfortunately, although the same alphabet came into use, the language was not made to coincide, and this divergence was the source of some trouble in Egypt. In 1879 the author read a paper before the United Service Institution on "Orders in the Field and the Means of Communicating Them," in which he pointed out some of the requirements of a military telegraph system. The theoretical idea of a field telegraph in the front and a permanent telegraph in the rear was by no means easy to carry out practically.

The Egyptian State telegraphs are constructed on the Indian model. The mileage of line and number of instruments in use he could not communicate to the society, as no reliable statistics on the subject existed. The instruments in use were Morse printers of the pattern exhibited before the society by Col. Mallock in 1872. These printers were mounted on a board and were very complete, the plug switch at the back, however, which was used to change the station from "terminal" to "intermediate" sometimes led to faults. The wire used was of the usual galvanised iron description, the gauges being No. 8 and No. 11. The poles were similar to those used in Austria, being perfectly straight and rather above the average size of those employed in this country. The insulators were of the Andrews pattern, and were attached to the alternate sides of the poles, as in France; this was before the introduction of arms. The batteries were Minotto's, and on a No. 8 wire 100 miles long 12 to 18 cells would be used, according to the state of the weather. As compared with the Leclanché battery, he would remind the society that Mr. G. E. Preece, in a paper read in 1873, pointed out that the relative values were as 100 to 160. As regards maps of the circuits he would state that it was very rarely that circuit maps were ever complete. The *personnel* was composed of Egyptians and Europeans, the head of the department being Mr. Le Mesurier, who also controlled the railways; the immediate head was Mr. Floyer. The superintendents and senior clerks were European. Of the ordinary clerks 70 per cent. were Egyptians, who could only telegraph in their own language. The linemen were Egyptians, and practically possessed no technical knowledge whatever, except as regards the maintenance of batteries and the removal of line faults. The telegraph system was first established in 1858 by Said Pacha: the task was a very difficult one. Although the native workmen possessed very little knowledge, yet their capacity for hard work to a great degree compensated for this.

Communication between the Turkish dominions was kept up by a four-wire line passing through El Kantara. It had been stated in the daily press that one object of Professor Palmer's expedition was to destroy this line east of El Kantara; but Lieut.-Colonel WEBBER did not believe that this was the case, as no possible object would be gained by such action. The proper course to have pursued would have been to have placed instruments in circuit with the wires at El Kantara, so as to tap the circuits. The line of the Eastern Telegraph Company is carried along the east side of the railway through Kalyub, Cairo, and Ismailia. Although during the day the lines are all easily workable, yet at night, owing to the heavy dew, considerable loss of insulation occurs. The Eastern Telegraph Company have three stations in Egypt, namely, at Suez, Cairo, and Alexandria. The wires are maintained by the Egyptian administration. The way-leave for the wires being a free one over the State railway; this line was very much injured during the war. The Eastern Company had no line along the canal. When the cable was laid from Alexandria to Port Said, the object was to enable the traffic to pass over the canal wires and thus avoid delay. On the arrival of the Indian contingent at Suez, the employés of the Eastern Company established telephonic communication in the harbour, &c., and generally rendered great assistance. During General Wilkinson's march the employés rendered great assistance in repairing the damaged lines; 6 miles of the latter belonging to the Eastern Company were completely destroyed by Arabs, but this gap was bridged over by means of an Egyptian line which was destroyed in other places only. Owing to a mistake made at the junction pole the circuits were not got through. At Serapum, Fayid, and Geneffeh armed posts were established. Repairs were made by the Telegraph Corps during the night, so that in two days the lines were put right in spite of great difficulties. The telegraph line of the Suez Canal Company consisted of one through wire and one wire with stations at every "gare," or places where the ships crossed each other. The line of the Canal Company was not appropriated, but after a time they consented to signal and receive messages, although opposition was offered at first. The whole line of the canal was guarded by blue jackets, who paraded twice a day along their respective beats in spite of the severity of the heat.

Lieutenant-Colonel WEBBER here spoke in the very highest terms of the important services which the Naval branch of the service rendered. At the termination of the war, the first thing done was to restore telegraphic communication as quickly as possible. The number of Egyptian employés available at that date was very small; but about the 25th of August everything was put right as regards the Egyptian lines between Port Said and Ismailia. The Egyptian clerks are only capable of sending foreign messages at a rate of five or six words a minute. This was found to be quite insufficient for the purposes of the army, consequently considerable delays were occasioned. During the campaign, field sounders with relays, were placed at Geneffeh, Fayid, and Serapum, and also at the headquarters at Ismailia. Of the three wires between Ismalia and Kassassin one was employed for railway purposes.

An important part played by the field telegraph was the putting into communication of the flanks of the advancing columns. As use was made in every case where possible of the existing lines, these were reconnoitred during the night by cavalry; the wires were found pulled down in several places, but one wire proved to be good throughout. When Kassassin was occupied, as is usually the case in Egypt, the office was found to be in great confusion, and owing to the general disarrangement of the leading in wires, considerable difficulty was found in putting matters straight, but after a short time, calls were obtained on the Cairo and Ismalia circuits, which proved to be Egyptian. One great source of difficulty in working was owing to the drying up of the batteries. Immediately after the battle of Tel El Kebir the block of message work was very great, and great delays necessarily occurred. One very important use of the telegraph was in connection with the railway working, and owing to the great care exercised by the non-commissioned officers and men, the trains were despatched without any accident occurring. The proper management of the railway telegraphs by the station-masters is a point of great importance, especially when a large number of messages are received, and when the lines are in a faulty condition. It was stated that in many cases messages which referred to the departure of a train often arrived at their destination a considerable time after the arrival of the train to which they referred. The Norwich accident, Lieut.-Col. WEBBER pointed out, was entirely due to the want of good management on the part of a station-master.

Lieut.-Col. WEBBER then explained the arrangement of the military Morse instrument. This can be used both for "open" and "closed" circuit working, or it could act as a relay. The close circuit principle was a very useful one, and as regards the extra expenditure of battery material which was occasioned by its use, this was by no means so great as was usually supposed to be the case.

The general equipment for the telegraph service sent to Egypt was the best ever arranged.

The insulators employed were of ebonite, with brass caps, in which was a groove; the wire was placed in this and then securely bound; ebonite shackles, with brass ends, were also used. The poles were painted with black and white bands, which were very useful, as it was a point of much more importance that the invading force should be able to see the line than that the enemy should not see it.

The military Morse instrument proved to be most satisfactory; its coils were wound to a resistance of 300 ohms, and the galvanometer to 26 ohms; the same was the case with the field sounder. The apparatus is provided with a good lightning protector, and all the connection wires under the base board are indicated on the top by slips of coloured wood.

The portable batteries used were of the Leclanché agglomerate form, sealed up by a tar mixture; this, however, was found to melt by the extreme heat of the climate. It is not an entirely satisfactory battery, since on a closed circuit it soon runs down.

As it is important that the line of telegraph be kept in good order constant inspection is necessary; in Africa this inspection was made two or three times a day, as pack animals caused constant breaks. Properly speaking, a line ought to have the poles well bedded and strongly stayed, but this is seldom done, owing to time being limited. The wire used was stranded.

Lieut.-Col. WEBBER then stated that as the result of practical experience, he considered that the wire should be made up into ¼-mile coils, as the ½-mile lengths were too heavy to be handled easily. The climbing of the poles was very laborious work, and to make it as easy as possible he considered that the spikes on the climbing irons should be on the inside of the leg instead of the outside as was usually the case.

With regard to battery maintenance in hot climates, Lieut.-Col. WEBBER exhibited a six-cell Leclanché battery in a wooden frame, designed by Professor Fleming. The cells of this battery were of "insulite," and were sealed at the top. The zinc plate was fixed in a groove, and each cell was divided by a porous partition, one chamber containing the zinc-plate, and the other the carbon-plate in manganese and carbon fragments; the latter was filled with a bichromate of potash and sulphuric acid solution. The insulite was not affected by heat; it could even be boiled with impunity.

During the 15 days of active operations in Egypt 26 offices were open and 5,000 messages were sent, a large proportion being transmitted ones. In some offices 150 to 200 messages a day were despatched. The head office at Ismalia served as the central office.

Classification of the messages is very necessary, as the important ones require priority of transmission; this classification requires considerable judgment. Many of the messages which had to be despatched were in cipher from the Admiralty. These were transmitted with wonderful accuracy owing to the good training which the telegraph staff had undergone in the postal telegraph service in England.

Lieut.-Col. WEBBER then referred to the work of Col. Bolton with reference to visual signalling, which was the handmaid of telegraphy.

On the restoration of peace, the repairs of the State telegraphs were at once undertaken, and by September 22nd everything was as nearly as possible all right, though it will take some time to get matters perfectly straight.

The fire at the Cairo railway station destroyed 15 wires, the chief destruction being caused by the fall of houses. [As regards the division of telegraphs into classes, it is generally agreed that this refers to difference of *matériel*.]

Lieut.-Col. WEBBER then referred to the use of the expression "line of communication" which had come into general use since the Franco-German war. There was no reason for supposing that the line of communication was distinct from any other in the army. The *matériel* employed depended very much upon the nature of the country through which the line was to pass. He expressed a hope that the use of the expression, "line of communication," would be dropped, as it was as inconsistent as division of maintenance would be, or as having a distribution of electricity for lighting purposes without a centre.

The use of the military telegraph required very great discretion, as its chief use was to transmit orders, and not for general purposes.

In the discussion which followed the reading of the paper,

Mr. VARLEY said that he would remind Col. Webber that in 1854, previous to Major Bolton's taking up the subject, the Electric and International Telegraph Company had sent out to the Crimea a complete telegraph equipment under General Neale.

Mr. ANSELL, in proposing a vote of thanks to Lieut.-Col. Webber for his paper, said that a mistake had been made in the statement that the Eastern Company's line was maintained by the State; the line was kept in order by the company's own staff. With regard to the line of communication being kept open he would point out that there was a head-quarters in England as well as in Egypt. Mr. PATEY seconded the vote of thanks, which was carried unanimously. The meeting then adjourned.

PHYSICAL SOCIETY.—NOVEMBER 25th.

Prof. CLIFTON, President, in the Chair.

A PAPER by Mr. William Ackroyd, on "Rainbows produced by Light reflected before entering the Raindrops," was read by the SECRETARY. The author investigated mathematically the rare phenomenon of three bows, and inferred that it would generally take place about sunrise or sunset. Mr. LECKY thought the effect had a simple explanation. It might be said to be due to two suns, one (reflected) appearing to be below the horizon.

Mr. SHELFORD BIDWELL gave an account of some experiments he had made to test the theory of Dr. James Moser, that the action of a selenium cell under light was due to the heat-rays making a closer microphonic contact between the selenium and the metal electrodes, by expanding the material. He submitted selenium cells to dark heat-rays, and found their resistance to *rise*. Under light-rays, however, their resistance fell. He therefore concluded that Mr. Moser's theory was erroneous, and that the fall in resistance due to the light-rays is the differential result of the rise due to heat, and the fall due to light. He also explained the "fatigue" of a selenium cell by use, as caused by its increase of temperature. When the cell cooled again the fatigue disappeared.

Dr. MOSER and Professor G. C. FOSTER made remarks on the paper, the former suggesting experiments to test the reversibility of the effects observed by Mr. Bidwell, and the latter seeking to reconcile Mr. Moser's theory with the new data.

Dr. JAMES MOSER then read a paper on a "General Method of Strengthening Telephonic Currents." This consists in forming a primary circuit of the telephone transmitters in derived circuit, a set of induction bobbins in derived circuit, and a charged secondary battery; the whole circuit having a very low resistance. Each primary bobbin has a secondary wound over it, and these secondaries are connected "in quantity" to the telephone line, which has at its remote end a set of telephones in derived circuit to the earth or return wire. In this way one line-wire serves to supply a large number of separate telephones—a hundred being employed by Dr. Moser to transmit music from the Hippodrome in Paris to the Place Vendôme. The system is applicable to long lines, and the induction noises are reduced by the subdivision among the separate telephones.

AMERICAN ELECTRICAL QUOTATIONS.—Telegraph, telephone, and electric light stocks were quoted on Wednesday, November 15th, as follows:—

Western Union Telegraph	81⅝
Mutual Union Telegraph	26
American Cable	68½
American Bell Telephone	179
Edison Electric Light	500
U. S. Electric Light	105
Fuller Electrical	23
Lugo Dynamo-Electric	150

EXPERIMENTS MADE AT THE PARIS ELECTRICAL EXHIBITION ON ELECTRIC LIGHTS AND MAGNETO AND DYNAMO-ELECTRIC MACHINES.

(By MM. ALLARD, JOUBERT, T. LE BLANC, POTIER, and H. TRESCA.)

THE results of these experiments have just been presented to the Académie des Sciences in four distinct series, of which the titles, with the date of presentation, are given below :—

Sitting of October 30th : Continuous current machines and regulators.

Sitting of November 6th : Alternating current machines and regulators.

Sitting of November 13th : Electric candles.

Sitting of November 20th : Incandescent lamps.

We thought it best to await the complete publication of this interesting work, although a little late, in order to present a succinct and faithful *résumé* of it to our readers, and to bring to light some direct inferences derived from the figures found by the Commission.

But it is important, first of all, to define some slightly novel terms used by the Commission to note the different functional elements, and to allow of making useful comparisons.

The unit of work adopted is the cheval-vapeur, whose value is 75 kilogrammetres per second. It is nearly equal to the English horse-power, which is, however, rather greater. Here is the exact relation :—

One cheval-vapeur = 75 kilogrammetres per second = 7,360 meg.-ergs.

One horse-power = 75·9 kilogrammetres per second = 7,460 meg.-ergs.

Resistances, electromotive force, and intensity are calculated in ohms, volts, and ampères. The following are the definitions of the special terms :—

Cheval électrique : Electrical energy produced by a generator calculated in chevaux-vapeur.

Cheval d'arc : Electrical energy consumed by an arc lamp in chevaux-vapeur.

Total mechanical return : Relation between the total electrical power furnished by the machine and the effective motive-power expended on the machine.

Mechanical return of arcs : Relation between the electrical power consumed by the arc or arcs and the effective motive-power expended on the generator.

Electrical return of arcs : Relation between the electrical energy consumed by the lamp or lamps and the total electrical energy furnished by the machine.

Luminous intensity : Measured in *Carcels*.

1 Carcel = 9·5 standard candles.

The Commission has only taken into its calculations the value of the photometric intensity designated under the name of *moyenne sphérique*. It supposes the luminous intensity measured in every direction and equalised in such a manner as to be the same in every direction ; this is the only method which represents the total of the phenomena, and which, with this title, can be compared in a rational manner with the various elements which produce this intensity.

There is no doubt that the figures given by manufacturers are much higher than those which correspond to the mean spherical intensity, since, in general, the luminous intensities are taken in the direction where the intensity is greatest.

I. CONTINUOUS CURRENT LAMPS AND MACHINES.

Table I. gives the whole of the results furnished by the continuous current machines supplying one or several arc lamps. The table refers to 13 series of experiments upon different systems with a number of variable lamps.

The mechanical observations give the speed of the machines in revolutions per minute, and the effective motive-power expended by each of them. It is to be regretted that these observations are not accompanied in each case by the extreme diameter of the induced revolving parts, which would allow of calculating a very important element—the absolute speed at which the induced part is turned. By comparing the absolute value of this speed with the total mechanical result, and with the mechanical result of the arcs, it would have been easy to observe the influence of great speed of revolution ; from this point of view the number of revolutions per minute furnishes no indication and presents, consequently, only a secondary interest. The electrical observations show us the actual practical limits between which electric lights will act, according to the size of the pencils of carbon and the volts and ampères supplied to the light. The intensity varies from 109 ampères with pencils of 20 millimetres in the lighthouse lamps to only 9·5 ampères in the Brush lamps.

The figure relative to the fall of potential of the lamp in volts is remarkable for its relative constancy, since it only varied from single to double—from 58 volts for 90 ampères to 32 volts only for the Weston lamps of 23 ampères. This low figure of 32 volts corresponds to a *short* arc, that of 58 volts to an arc relatively *long ;* the first shows that the contra-electromotive force developed in the arc is very variable, still very badly defined, and that, in some cases, it may be notably lower than 32 volts.

The photometric observations show that the arc produces all the luminous intensities from 1,000 carcels to only 40 carcels, according to the size of the carbons and the electrical energy expended.

The comparison of the results undoubtedly furnishes the most valuable indications. The comparison between the total mechanical result of the machines shows the great superiority of the Jurgensen machine, which transforms into electrical energy 97 per cent. of the mechanical work which is supplied to it, but there is a counteraction to this advantage, for we only find in the arc 32 per cent. of the mechanical power expended ; that is to say, less than any of the others, which furnish in the arc as much as 70 and even 77 per cent. of the mechanical force expended. These differences arise from the external resistances of the circuit being out of proportion to the internal resistances of the machines, and also from the passive resistances proper to each system.

This fact is especially noticeable when one compares the figures of the four last lines of the table. It is seen, for example, that the Weston machine, supplying ten lights, produces more light per mechanical horse-power than the large lighthouse lamps supplied by a Gramme machine. The comparison of these figures would tend to make one believe that *one gains by division of the light*, since the small Weston lamps furnish 65·3 carcels per horse-power, and the lighthouse lamp only 60 carcels. This is not the case, however, and when we compare the electric energy consumed by each of the lights, we find that the large one produces 128·8 carcels per arc horse-power, whilst the small produces only 85. This is because the number of carcels per mechanical horse-power combines the result of the machine and the result of the lamp, whilst the number of carcels per arc horse-power comprises only the expenditure of electrical energy of the lamp. Thus, for example, in experiment VII. the result of the Gramme lamp is one of the best, not to say the best of all, since it produces 121·6 carcels per arc horse-power ; we only find, however, 61·8 carcels per mechanical horse-power. This is because, under the conditions of the experiment, the total mechanical result was only 0·62. It was found, therefore, in this particular case that a machine in bad conditions of working was supplying lamps placed, on the contrary, in excellent conditions.

The practical results of these experiments are as follows :—

All machines transform, on an average, 85 per cent. of work expended into electrical energy.

We find in single lights 47 per cent. in electric energy of the mechanical work expended upon the machine, 60 per cent. in the lights arranged from three to five in tension, and up to 70 per cent. when from 10 to 40 lamps are placed in circuit.

The return in carcels per mechanical horse-power is nearly the same in every case, or, on an average, 35 carcels per mechanical horse-power, whilst the arc horse-power furnishes, on an average :—

120	carcels in lights	of	from 800 to 1,000	carcels.
100	„	„	250	„
71	„	„	40	„

The relation of the intensity of the current to the number of carcels presents also some interest. We find, on an average, that—

lights from 800 to 1,000 carcels produce 9 carcels per ampère.
250 to 300 „ „ 6 „ „
100 „ „ 5 „ „
40 „ „ 4 „ „

One can thus deduce from table I. the most suitable relation between the diameter of the carbons and the current which traverses the arc. This calculation, which the committee has not made, would furnish, however, interesting information, and would allow of appreciating in some measure the photometric advantage in the employment of two fine pencils burning very rapidly.

power, which represents 79·6 carcels per mechanical horse-power, against 60 carcels for lights of equal power with a continuous current. This experiment shows that the electric power is better utilised in alternating current lighthouse machines than in continuous current machines, but it creates no superiority in favour of alternating currents, since in Berjot lamps of 150 carcels the result is 59·7 carcels per mechanical horse-power, and it falls to 33·3 carcels in the differential Siemens lamps of 39 carcels. Alternating currents have, therefore, shown an inferiority of result in the case of lights of low power.

III. Electric Candles.

By way of definition, one includes under the name of *candles* all lights in which the carbons are placed parallel.

Table I.

RESULTS OF EXPERIMENTS MADE WITH CONTINUOUS CURRENT GENERATORS AND LAMPS.

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
	Formulæ.	Gramme. 1 Lamp.	Jurgensen. 1 Lamp.	Maxim. 1 Lamp.	Siemens. 1 Lamp.	Siemens. 2 Lamps.	Bürgin. 3 Lamps.	Gramme. 3 Lamps.	Gramme. 5 Lamps.	Siemens. 5 Lamps.	Weston. 10 Lamps.	Brush. 16 Lamps.	Brush. 40 Lamps.	Brush. 38 Lamps.
1. Mechanical Observations.														
Speed of generators, revolutions per minute	...	475	800	1017	737	1330	1535	1695	1496	826	1093	770	700	705
Effective work of motor, horse-power	T	16·13	21·68	4·07	4·44	5·31	5·32	8·11	8·00	5·05	13·01	13·39	29·96	33·25
2. Electrical Observations.														
Resistance of generator, ohms ...	...	·33	·45	·70	·66	1·68	2·80	·52	4·57	7·05	1·88	10·55	22·38	22·38
„ circuit without lamps, ohms ...	...	·10	·82	·25	·12	·13	1·50	1·25	·62	4·50	1·50	2·56	2·60	7·90
Total resistance, ohms	R	·43	1·27	·95	·78	1·81	4·30	1·77	5·19	11·55	3·38	13·11	24·98	30·28
Intensity of current, ampères ...	I	109·2	90	33	35	26·2	18·5	19·0	15·3	10·00	23	10	9·5	9·05
Fall of potential at lamps, volts	E	53	58	53	53	44·5	41	53	49·8	47·4	32	44·3	44·3	44·3
Work in total circuit	$\frac{R I^2}{75\,g}$	6·97	13·99	1·41	1·29	1·69	2·00	·87	1·65	1·57	2·43	1·79	3·07	3·72
„ one lamp	$\frac{E I}{75\,g}$	7·87	7·09	2·37	2·52	1·59	1·027	1·369	1·04	·64	1·00	·60	·573	·573
„ all lamps, horse-power	l	7·87	6·97	2·31	2·52	3·18	3·08	4·11	5·20	8·20	10·00	9 60	21·88	20·79
Total electrical work	T^1	14·84	20·96	3·72	3·81	4·87	5·08	4·98	6·85	4·77	12·43	11·39	24·95	24·51
Mean electromotive force ...	$n E + R I$	102	172	84	80	136	203	193	328	353	398	840	2009	1971
3. Photometric Observations.														
Diameter of carbons, inches ...	...	·79	·91	·43	·71	·55	·51	·55	·47	·39	·35 & ·39	·43	·43	·43
Horizontal luminous intensity, carcels	...	952	607	246	210	142	50	155	112	67	92	37	63	63
Horizontal luminous intensity, maximum carcels	...	1960	...	465	805	537	227	357	184	72	154	76	78	78
Average spherical luminous intensity	l	966	688	239	306	205	82	167	102	52	85	38	39	39
Average total intensity	$L = n\,l$	966	688	239	306	410	246	501	510	260	850	608	1500	1482
4. Performances.														
Total mechanical work	$\frac{T^1}{T}$	·92	·97	·91	·86	·92	·95	·62	·86	·94	·95	·85	·83	·73
Mechanical work in arc	$\frac{t}{T}$	·43	·32	·57	·57	·60	·58	·51	·65	·63	·77	·72	·73	·62
Efficiency of arc	$\frac{t}{T^1}$	·53	·33	·62	·66	·65	·61	·83	·76	·67	·80	·84	·87	·85
Carcels per mechanical horse-pwr.	$\frac{L}{T}$	60	31·7	58·7	68·9	77·2	46·2	61·8	63·8	51·5	65·3	45·4	52·1	44·4
„ electric horse-power..	$\frac{L}{T^1}$	65·1	32·8	64·2	80·3	84·2	48·4	100·4	74·5	54·6	68·4	53·4	62·6	60·5
„ arc horse-power ...	$\frac{L}{t}$	128·8	98·7	103·5	121·4	129·3	79·9	121·6	98·1	81·3	85·0	63·3	71·7	71·4
„ ampère	$\frac{l}{I}$	8·85	7·64	7·24	8·74	7·82	4·43	8·79	6·67	5·20	3·70	3·80	4·11	4·11

II. Alternating Current Machines and Lamps.

The experiments of the Committee relating to these lamps and to these machines are comparatively few, for they were only made upon three types of lamps and two types of machines :—

1° Méritens machine, supplying 1 Serrin lighthouse lamp.
2° Méritens machine „ 5 Berjot lamps.
3° Siemens machine „ 12 differential lamps in 3 circuits.

In the first case the mechanical and photometric effects only could be measured. The lighthouse lamp produced a light whose mean spherical intensity was 931 carcels for an expenditure of mechanical power equal to 11·7 horse-

Experiments were made upon the Debrun, Jahlochkoff, and Jamin candles. The experiments on the Debrun candle are very incomplete. It was proved by the experiments that with 10 ampères and 50 volts difference of potential at the base of the candle, the light produced is 31·6 carcels per arc horse-power and only 14 carcels per mechanical horse-power. The Jablochkoff candle (pencils of 4 millimetres) works with 42 or 43 volts difference of potential and 7·5 to 8·5 ampères. It produces from 46 to 51 carcels per arc horse-power, and from 31 to 35 carcels per mechanical horse-power.

The working of the Jamin candle might almost be called electrical sleight of hand.

By placing 32 candles upon the machine, a current of 6·1 ampères and 77 volts difference of potential at the base,

lights of 16 carcels are obtained, with a result of 25 carcels per arc horse-power.

The most favourable conditions are obtained with 48 candles upon the machine. The current is 5·1 ampères, the difference of potential 69 volts, the power of each light 17·4 carcels, and the result per arc horse-power 36·4 carcels.

When 60 lamps are placed upon the machine the working becomes quite fantastic. The current is not more than 3·5 ampères and the difference of potential 74 volts. The power of each arc light is 9·4 carcels, and the return per arc horse-power 27·3 carcels. One may well ask what can be the practical interest of arc lights working with 3·5 ampères and 74 volts difference of potential, and what would be the steadiness of an arc light working in these conditions?

These few figures show that candles are transition lights, intermediate between regulators, properly so called, and incandescent lamps, giving lower results, and the employment of which recommends itself much more by the simplicity of their component parts than by their intrinsic value.

Without disputing the advantage of the automatic relighting of the Jamin candle, we come to a conclusion which, taking into consideration the figures of the committee, is the very opposite of that arrived at by themselves, that the Jamin candle is greatly inferior to the Jablochkoff candle, both as regards the number of carcels produced per mechanical horse-power, and that of the carcels produced per arc horse-power, however superior the electrical result of the arcs may be. This is because the Jamin candle acts *too exactly*, if one may use this expression, that is to say, with the intensities of current too near the acceptable limit. In these conditions, the small superiority resulting from a better electrical result is far from compensating for the loss of light resulting from the employment of an arc of too small volume compared with the dimensions of the pencils of carbon between the extremities of which the arc plays.

IV. INCANDESCENT LAMPS.

The experiments undertaken upon incandescent lamps in closed globes have shown that we must not require from them a luminous power much greater than two carcels, at least as regards the types represented at the Electrical Exhibition.

The experiments undertaken by a special sub-committee, and the results of which were published in the ELECTRICAL REVIEW of 17th June, 1882, page 434, have given practically the same results as those of the principal committee.

We re-produce in the subjoined Table II., the results which relate to the figures of the principal committee; the measurements have been more especially taken from an electrical point of view. The mean spherical luminous intensity is, for the Maxim lamp, 0·74 of the horizontal intensity when opposite, and 0·78 of the horizontal intensity at 45°. In the Edison lamps, the mean spherical intensity is equal to 0·98 of the horizontal intensity when opposite.

The horizontal intensity at 45° is equal to 1·33 of the horizontal intensity when opposite.

For Lane-Fox lamps, the mean spherical luminous intensity is equal to 0·58 of the horizontal luminous intensity when opposite, and to 0·69 of the horizontal luminous intensity at 45°.

The Swan lamps had similar co-efficients.

TABLE II. EXPERIMENTS ON INCANDESCENT LAMPS.

	Maxim.	Edison. 16 candles.	Lane-Fox.	Swan.
Ohms (under heat)	43	130	28	31
Volts	75	91	50	48
Ampères	1·74	0·7	1·77	1·55
Kilogrammetres	13·28	6·50	8·95	7·62
Mean spherical luminous intensity	2·80	1·57	1·64	2·19
Carcels per arc horse-power ...	15·89	18·12	13·74	21·55

For lights of 1·2 carcels (13 candles) one could only reckon upon an effective lighting (mean spherical intensity) of 12 to 13 carcels per arc horse-power, and about 10 carcels per mechanical horse-power by means of incandescent lamps.

GENERAL CONCLUSIONS.

Regulators furnish about 100 carcels per arc horse-power.
Candles ,, ,, 40 ,, ,, ,,
Incandescent lamps ,, 10 ,, ,, ,,

The economical values of these three systems are, therefore, about in the ratio of the numbers 1, 3, and 7, seeing that in each system the most intense lights always give the best result.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

SECONDARY BATTERIES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—At one of the last meetings of the Academy of Science, Paris, M. G. Planté described a new method of forming secondary batteries, and being now actively engaged in the practical applications of accumulators, I thought that a few remarks might interest your readers upon this method. Following the recommendation of M. Planté, I have myself experimented this method at the laboratory of M. de Kabath, Paris, and regret to say, with all due respect to the great scientist and *savant*, that I cannot agree with his conclusions.

This method, as well as the one previously proposed by M. Planté, viz., of heating the solution while the elements are being formed, do not present any real practical advantages. No doubt both methods as applied to the formation of a Planté cell will quicken such formation, but reducing the lead, either by heating the solution or attacking the surface of the lead by strong nitric acid, seems to me to upset the very aim pursued through the whole scientific researches of M. Planté.

In producing an artificial formation of peroxide and reduced lead, the new Planté cell will follow the same physical and chemical laws as do all other secondary batteries where the formation of the peroxide and reduced lead are mechanically attached.

One of our leading scientists, who was the first to endorse M. Faure's invention in the scientific world, has

on several occasions expressed his opinion that while by adding the peroxide mechanically, the first results of a secondary battery so formed are exceedingly satisfactory, yet the action of the current combined with the action of the sulphuric acid penetrating to the heart of that mechanically attached peroxide, at a given moment (which we might consider as about two months for a secondary battery in active service) produces a new action of the current on the lead blade itself, which then gets peroxidised on its entire surface with a layer of crystalline peroxide, as can be distinctly seen in all the batteries deriving directly from M. Planté in which the formation is made by the sole action of the electric current. This layer of crystalline peroxide by its molecular formation being entirely different from the peroxide mechanically attached, they become by the action of the current independent of each other, and as the oxide, when not in direct contact with the metallic blade is virtually a non-conductor, it becomes in such a case an useless element and a dead weight.

I thought it necessary to give these remarks before expressing any definite opinion upon this new method of forming secondary batteries as described by M. Planté, and which throws us back to all the defects of the batteries wherein the peroxide is mechanically attached, for a layer of peroxide obtained by charging the molecular formation of the lead will follow exactly the same laws.

To conclude, I will say that all the tests that have been made by myself and others have fully demonstrated that as long as lead will be used to form the elements of secondary batteries *the only safe and practical way of forming the layers of peroxide is by the action of the electric current itself.*

The only recommendation I can make is to use 20 per cent., even 25 per cent., and sometimes as high as 30 per cent. of acid, instead of 10 per cent., as has been adopted by M. Planté.

This solution cannot be applied where felt, parchment paper, or any other similar perishable substance is used, and from this I conclude that the problem at present to solve is to obtain *the maximum surface to the minimum weight of lead.*

Respectfully yours,
CHAS. W. FARQUHAR.

Barcelona, Spain.
November 22nd, 1882.

ELECTRICAL ENGINEERING CLASSES.

To the Editors of The Electrical Review.

Gentlemen,—In reply to your request for information respecting the manner in which the classes on Electrical Engineering are conducted at the City and Guilds of London Institute, the experiments are *not* carried out under the direct supervision, either of the professor or his assistants, students being left to find employment for themselves. The number of students is far in excess of the accommodation: one may see a dozen to twenty striving to read one am-meter and wondering what it is all about. Of formulæ there is a good supply, but practical examples are yet in the future. The classes are much too large to allow of individual attention, and such is not to be desired until the assistants are a wee more courteous. Home lessons *nil*. The only experiments I have seen performed in view of the entire class consist of the deflection of the leaves of a condensing electroscope by means of a stick of shellac rubbed with the skin of a defunct puss, and the production of a spark by means of an induction coil.

Last session we were shown a long-suffering cylindrical condenser of calculable capacity which ornamented the right-hand corner of the table for a considerable period. This, together with the exhibition of a 0·3 m. f. condenser and a signalling key, makes up the sum of the experiments (?).

I agree with your correspondent F. W. F., except as to the experiments. Does he attend the Monday evening class? If so, surely he is in error? I have given up the laboratory altogether, for it is a mere waste of time when half-a-dozen bewildered students are each trying to measure the resistance of the same battery with the same apparatus at the same time, alarming results being the consequence. I am in hopes that when we are located in the new building things will mend, if not I shall evaporate.

Yours truly,
SEA BOOTS.

To the Editors of The Electrical Review.

Dear Sirs.—In reference to the above I should feel obliged if you would insert the following remarks on F. W. F.'s letter which appeared in your last issue. As, in addition to the professor, there are three demonstrators on duty in the laboratory of the Physical Department of the City and Guilds of London Technical College, Finsbury, on Monday and Friday evenings, I cannot understand how F. W. F. can affirm that "the only assistance the student receives as a rule in carrying out the experiments is from the written instructions attached to the instruments." Each of these demonstrators is only too glad to smoothe away any difficulties the student may meet with. Again, since a considerable time is regularly spent in overlooking "the home lessons" done by the students, I presume that your correspondent means by his surprising statement that "no home lessons are given to the students to prepare," merely that there are no passages from text books given to be read-up. In fact, leaving out of account the questions given during the lecture to be worked out by the students before the next lecture, if every student regularly wrote up his lecture notes, worked out the results of the experiments he has himself made in the laboratory in accordance with the written instructions urging him to do so, and lastly, graphically recorded the results of each experiment on the sheets of squared paper given him *gratuitously* for that purpose, he would, no matter how ardent his desire to work at home, have quite as many "home lessons" as he could possibly do.

That the temporary laboratories are immensely overcrowded, in consequence of the unexpectedly rapid increase in the number of students attending the Electrical Engineering Classes at Cowper Street, is only too obvious to every one; but any student who is unwilling to put up with some inconvenience until the opening (unavoidably postponed this term) of the new Finsbury Technical College, on the building and fitting of which the Institute is spending many thousands of pounds, should remember that he always has it in his power to slightly diminish the present crowding of the temporary laboratories.

Very truly yours,
ARTHUR C. COCKBURN,
Chief Demonstrator.
Physical Department, City and Guilds of London College.

INCANDESCENT AND ARC LAMPS ON THE SAME CIRCUIT.

To the Editors of The Electrical Review.

Sirs,—Allow me to make a few remarks in reference to the recent articles which have appeared in your journal on the subject of incandescent and arc lamps on the same circuit.

With most systems of electric lighting the union of these two kinds of light is impracticable, but by the Gülcher low tension system, with the arrangement of parallel circuits, it is perfectly easy to light both incandescent and arc lamps by the same dynamo machine. All the installations we have hitherto had to carry out for our customers have been made with that combination, to their perfect satisfaction, thus proving at a glance that our system meets the requirements of the public.

If the dynamo machine is running regularly at its proper speed, there is not the slightest fluctuation perceptible in the incandescent lamps, and the light is just as steady as if they were worked independently of the other.

Everybody can see this at our Battersea works, where a single No. 4 dynamo works 4 large lamps of 2,300 candle-power each and about 50 incandescent lamps of 20 candle-power each.

The reason why our system is so perfectly suitable for this combination is simple enough. It is a well-known fact that so long as the proper and regular speed of the Gülcher dynamo is maintained, the electromotive force remains nearly perfectly constant, while on the other hand the quantity of the current varies in direct proportion to the number of lights and in inverse ratio to their resistances. Therefore, even if the resistance of one of the arc lamps varied considerably, owing to its not working properly, the fluctuations of the light would not be perceptible in the in-

candescent lamps on other circuits, as only that one branch circuit would be supplied with more or less current, according to the variable resistance of the arc lamp, while the current would not vary at all in the incandescent lamp circuits, but would remain constant as long as the speed of the dynamo machine was regular; and even in case the resistances of two or more arc lamps varied and absorbed more or less current in their branches at a time, the current in the incandescent lamp circuits would still remain constant.

I am, dear Sirs, yours faithfully,

R. J. GÜLCHER,

Electrician of the Gülcher Electric Light and Power Company, Limited,

121, Bishopsgate Street Within, E.C.

November 24th, 1882.

NOTES.

NOTICE TO READERS.—Subscribers are hereby notified that in future the supply of back numbers of the ELECTRICAL REVIEW cannot be guaranteed by the publisher; it is therefore expedient that those who desire to complete their sets should do so at the first convenient opportunity. The publisher also desires to give notice that after December next all copies dated six or more months previously will be supplied only at enhanced prices, that is to say, 4d. numbers will be charged 6d., and others at similarly advanced rates.

THE ELECTRIC LIGHT.—Last Monday night the electric light was exhibited for the first time in Port Elizabeth by the South African Brush Electric Light and Power Company. Six lamps were lighted—three in Market Square and three on the Hill, near the Port Elizabeth Club—at half-past 8 o'clock, and were kept lighted till 12 o'clock. A large concourse of people gathered together at both places to see the novelty, and all were much pleased with the brilliancy of the lights and the steadiness with which they burnt. What the relative cost of production may be we are not at the moment prepared to say, but about the brilliancy of the electric light, together with a softness it is difficult to describe, there can be no doubt. We presume the company will now make some proposal to the municipal authorities in regard to the expense of lighting the town by the Brush light system.

We have been favoured with the following particulars of the electric light now being exhibited in Port Elizabeth:—The engine-room is at the Phœnix Works (Messrs. Mangold Bros.), the engine being of 7 horse-power, made by Messrs. Hornsby and Sons, Grantham, and which drives the generating machine at over 900 revolutions per minute, the speed of the engine itself being 180 revolutions per minute. The wire is carried to three lamps in the Market Place, and thence to three lamps round the Vley, the total length of the circuit being about one mile.

The lights will be exhibited for one month, from one hour after sunset to 12 o'clock.

The present exhibition has been erected under the superintendence of Mr. R. L. Cousens, electrician of the South African Brush Electric Light and Power Company, Limited. —*E. P. Herald, October 18th.*

THE ELECTRIC LIGHT IN SOUTH LONDON.—The Electric Lighting Committee of the Rotherhithe Vestry reported that at the adjourned conference of representatives of local bodies a resolution was passed in favour of the vestries and boards lighting their own districts. The committee recommended that a special meeting of the vestry be called to consider the whole question, and that in the meantime the clerk obtain information from the various companies as to their terms for supplying the public and private lighting of the parish.

The recommendation was adopted.

In reply to Mr. Simmons at the Camberwell vestry, the clerk (Mr. J. W. Marsden) stated that applications had been received from electric lighting companies for four provisional orders and one licence.

Mr. Middlemass, chairman of the general purposes committee, brought up a report recommending that permission be given to the committee of the International Electric and Gas Exhibition at the Crystal Palace, on their application, to use the lamp-posts on the Crystal Palace Parade for the purpose of exhibiting improved lights, and that the same be erected and removed under the supervision of the surveyor, and the old burners and lanterns reinstated to the satisfaction of the vestry; and that an agreement be prepared by the vestry clerk in accordance with these terms.

The recommendation was agreed to.

A letter was received by the St. Saviour's Board of Works from the vestry of Camberwell, stating that at an adjourned conference of delegates it was resolved to recommend the local boards to apply for licences under the Act. A letter was received from the vestry of St. George, Hanover Square, on the same subject. The communications were referred to the Lighting Committee.

The Electric Lighting Committee of the St. Olave's Board of Works reported that at the adjourned conference of delegates from South London parishes, a resolution was passed in favour of the local authorities keeping the power to light the parishes in their own hands. The committee also reported that they had received a tender for providing the Lane-Fox system at £3 per lamp per year, the board to have the power at the end of five years of purchasing the stock at the original cost. On the motion of Mr. Scovell it was resolved: "That a special meeting of the board be convened for Tuesday, the 9th January, 1883, at 12 o'clock, to consider the expediency of applying to the Board of Trade for a licence to supply electricity for public and private purposes within the area of the district." The motion was seconded and agreed to.

THE METROPOLITAN BRUSH ELECTRIC LIGHT AND POWER COMPANY *v.* CRUICKSHANK.

(Before Mr. Justice Field and Mr. Justice Stephen.)

This was an action by the company to recover a sum of £20 as the balance of the amount due on ten shares in the company. Bringing the action in the high court, they applied for judgment under the Judicature Act (Order XIV.) as in an action there could be no defence. The defendant, in answer to the application, swore that a certain pamphlet produced was a pamphlet or prospectus of the company, which had upon its title-page these words, "Sole concessionaires for erecting Brush Arc and Lane-Fox Incandescent lights in London and Westminster and the whole of the metropolitan postal district." And then he swore that in May last "he applied for and had allotted to him ten shares of £5 each in the company, and paid £10 upon application, therefore relying upon the company and upon the faith of the representations by the company; and that had it not been for such statement he should not have applied for any of the shares; and that he had since ascertained that such statements were untrue, and that the Anglo-American Brush Electric Light Company and the British Electric Light Company had at that time the right to erect the lamps referred to within the district; and that he believed that the statements referred to were known by the company to be untrue." The Judge at Chambers was not satisfied with this affidavit, and the defendant made a further affidavit that he first became aware that the statement referred to was untrue, a day or two before the action was brought. The learned judge (Mr. Justice Watkin Williams) was still not satisfied with the affidavit as not distinctly showing that the defendant had seen and read the pamphlet before he applied for his shares, and so he gave leave to enter judgment for the sum claimed. This was an appeal by the company from that decision.

Mr. Bower appeared for the company; Mr. Rose-Innes for the defendant.

The Court, in giving judgment yesterday, said they thought that a defence was so far sufficiently stated as to require that it should be tried. They were not now to decide whether or not it was true in fact, but whether it was substantially stated and alleged, and they thought that it was. The defendant had sworn that he had applied for and taken the shares "relying upon, and on the faith of," the representation referred to, and that just before the action he had found out that it was false and fraudulent, and he was entitled to have that question tried. A party who after he had entered into a contract discovered that he had been induced to enter into it by means of fraud was entitled to set up that ground as a defence. The order for judgment, therefore, must be set aside, especially as it was shown that this action—only for £20—had been brought in the high court for the very purpose of thus obtaining judgment summarily.

THE ELECTRIC LIGHT AT THE BIRMINGHAM CATTLE SHOW.—The Birmingham *Daily Post* of the 28th ult. says:—"Perhaps one of the first things to attract the attention of visitors in the implement department is an installation of electric light by Messrs. Smith and Chamberlain, of the Solar Works. The special permission of the Council has been given for this display at Messrs. Tangye's stands, Nos.

10 and 24, and the installation is invested with additional interest and importance by the fact that this is the first time the Edison light has been shown in Birmingham. The results achieved are such as to excite considerable admiration, and to show beyond dispute the ease and advantage with which the electric light may be adapted to domestic use. There is no attempt, in consequence of the limited space, to illuminate any extensive area, but simply an endeavour to show what may be done by the electric light in rooms such as private libraries, picture galleries, dining-halls, drawing-rooms, &c. The light is produced by two of Edison's dynamo-electric machines, each driven by Messrs. Tangye's coupled gas-engines of 2½ horse-power (?). Hitherto it has been difficult with gas-engines to secure a steady electric light owing to the intermittent motion, but in the present invention there are two impulses at each revolution, which causes a perfectly steady working, and in no way disturbs the light. One of the dynamos is equal to supplying sixty lights, and the other fifteen, and they convey the current to four chandeliers, ten pendants, a three-light bracket and a hall lamp. The chandeliers are of such artistic and elegant design that in themselves they are well worth seeing. The illumination is brilliant without being so intense as to be painful to the eyes, and its steadiness and entire absence of heat should make it exceedingly desirable for the purposes to which Messrs. Smith and Chamberlain show its adaptability."

THE LANE-FOX LAMP.—The directors of the Anglo-American Brush Electric Light Corporation have placed the direction of the Lane-Fox Incandescent Lamp Department, Portpool Lane, in the hands of Mr. St. George Lane-Fox.

FITTINGS FOR THE ELECTRIC LIGHT, &c.—Messrs. Faraday & Son, of Berners Street, W., have, we believe, designed and manufactured the special fittings ordered for the Swan lamps that are being supplied to H.M.S. *Himalaya*. These are of a less fanciful type than those recently made by the same firm for the *Invicta*, the main requisite in a troop-ship being safeguards against tampering on the part of "larkers."

THE first instance of the employment of the incandescent electric lamp for the lighting of a West End shop-front is probably that of Mr. Mayall's, at the corner of New Bond Street and Grafton Street. Since September thirty-six Swan lamps, fed by a Gramme machine, have brilliantly illuminated the life-size photographs in the windows. The work has been carried out by the above firm, and special fittings have been designed representing a Renaissance allegorical sun, flanked by vines, from the tendrils of which the little bulb lamps are made to depend. The design is a complete departure from those in vogue for older illuminants, while the central feature of the sun has an appropriate reference to the photographic art.

THE electric light is, we understand, to displace the old sunburners in the theatre of the Royal Institution, Albemarle Street, during the forthcoming Christmas and Friday evening lectures. The Swan lamp is now festooned along the gallery front, being strung between the beaks of brackets representing a species of "swan with two necks." Other lamps are fixed in the circular roof, their light being directed by means of a parabolic reflector strongly upon the screen opposite the audience. It has been found that forty incandescent lamps thus disposed light the theatre as effectually as the 126 gas jets hitherto employed. The arrangement and details have been carried out by Messrs. Faraday & Son.

THE ELECTRIC LIGHT IN LONDON.—The electric lighting companies, says *The Building and Engineering Times*, are not disheartened by the failure of some of them to secure mercantile success, and a number have given notice of their intention to apply to the Board of Trade under the Act of 1882 to enable them to light the City by electricity. A fair field and no favour should, and we hope will, be the order of the day, but in the multitude of competitors there may be some inconvenience occasioned to the public. The feeling in the Commission of Sewers is that all future experiments must be made at the expense of the companies themselves, and not at that of the ratepayers.

ELECTRIC LIGHTING IN CROYDON.—Mr. Charles Lee, in writing to the *Croydon Chronicle*, says :—"That the whole problem of lighting by electricity has been solved by the 'Brush' or any other company is quite contrary to my conviction, and was never stated by me, in fact, I am fully persuaded we have only just touched the fringe of the subject, and that much more than we have now the slightest conception of will be accomplished in the (perhaps near) future, both as to lighting and locomotion. What I said was that the South Eastern (please to take due note of the name) Brush Electric Light and Power Company, Limited, were prepared to undertake the lighting of a certain part of Croydon at a price not exceeding that of gas. If they do this at a loss to their shareholders, that is a question to be settled among themselves; and with the guarantees Local Boards can demand there is nothing to be lost, but everything to be gained by the public of Croydon.

"I have been led to look into this subject as treasurer of the new Wesleyan church in the Lower Addiscombe Road, which it was desired to light by electricity; we tried in all quarters, but for the present we are blocked, I trust not for long. In the last number of the *London Gazette* will be found a notice of application to the Board of Trade for a Provisional Order by the South-Eastern Brush Electric Light and Power Company, Limited, which, if granted, will give to Croydon the great desideratum, the electric light."

ELECTRIC LIGHTING.—We understand that Messrs. Lewis, of Liverpool, are lighting up one of their houses with fifty Pilsen arc lamps, and they have appointed Messrs. Woodhouse & Rawson, of London and Belfast, contractors for carrying out the work.

ELECTRIC lighting experiments are about to be made at Aberdeen, as will be observed below, and every effort is to be made to enable the public to see the light at its best.

THE Liverpool Health Committee last week decided not to allow the further adoption of the electric light for shops in the town until the matter has been dealt with by the Council.

THE electric light, after a good trial, has been found to suit admirably the dye works of Messrs. P. and P. Campbell, Perth. The light is used in the four principal departments, viz., the dye house, the cleaning house, the finishing house, and the overhauling room.

MR. BECKINGSALE visited Aberdeen on the 28th ult., for the purpose of arranging the positions of lamp-posts for Brush arc lamps, sixteen of which are to be placed in Castle Street, part of Union Street, Market Street, and Guild Street. They will range from 60 to 90 yards apart, and will be placed at the same height as those in Dundee (about 20 feet). Three lamps are also to be placed in the public hall in the Municipal Buildings. The authorities of the town have entered into a contract with the Brush Electric Light and Power Company of Scotland for this installation. Mr. Beckingsale is the general manager and electrician of the company. We also learn that the temporary installation of the Brush system in Dundee, concerning which we made some remarks in our "Notes" columns last week, is now working very satisfactorily.

THE TRANSMISSION OF MOTIVE-POWER.—We read that MM. Piette and Krizik, the inventors of the well-known "Pilsen" arc electric lamp, have, at an agricultural gathering at Lundenburg, in Germany, been driving an ordinary threshing machine by electricity and illuminating at the same time the yard in which the machines were exhibited.

THE ANGLO-AMERICAN "BRUSH" CORPORATION.—At a meeting held on the 29th ult., it was resolved that a call of £3 per share be made on the £4 paid-up shares of the Corporation, to meet the cost of extension of works and machinery and manufacture of stock, the same to be payable in instalments of £1 each on the 1st January, the 1st February, and the 1st March, 1883.

ELECTRICAL EXHIBITION, ROYAL AQUARIUM.—We are informed that the opening of this exhibition is now post-

poned till the 21st December. The transept is set aside for various systems, including those of Henley, Gülcher, Siemens, Paterson, &c., while the courts on the ground-floor will be occupied by Latimer Clark and Co. (Hopkinson), Jablochkoff, Duplex, Edmundson & Co. (Swan), Dixon and Goulard, D'Humy, and perhaps Lane-Fox. The *annexe* will be the locality for the Thomson-Ferranti system, and for an interesting general collection, including eleven or twelve motors. The picture galleries, &c., will be lighted by the Edison Company and Messrs. Woodhouse and Rawson. The exhibition will also include telephones and electrical meters.

THE STEAMSHIP "SCOTIA."—The s.s. *Scotia* of the Tele graph Construction and Maintenance Company has left the Victoria Docks for the Thames Iron Works and Ship Building Company's Dry Dock, where she will be overhauled previous to her going up to the company's works off Greenwich. She will then ship the new cable which has been made there for the Eastern Extension Company, and which is to be laid between Suez and Aden.

EXTENSION OF THE FRENCH GOVERNMENT CABLES ON THE NORTH COAST OF AFRICA.—The s.s. *International*, Capt. W. F. Wardroper, arrived on Monday evening, the 27th inst., at her moorings off the Silvertown Telegraph Works, on her return from laying, for the French Government, cables along the coast of Tunis. These cables consist of four sections, namely, from Soussa to Sphax, from Sphax to Bordj-Djerib, on the west coast of the island of Djerba, from Bordj-Djerib to Gabes, and from Aghir, on the east coast of Djerba, to Zarzis, on the frontiers between Tunis and Tripolis. The *International* left the Thames on the 21st September last, and the expedition was in charge of Mr. Theophilus Smith, assisted by Messrs. H. Benest, J. Rymer-Jones, J. W. A. Knox, and others, whilst the French Government was represented during the making and laying of the cables by Mr. J. Rambaud, engineer in the French Telegraph Administration, assisted by Messrs. Schaeffer, Durregne, and de Nerville. Mr. Cheylus, Directeur-ingénieur des Télégraphes, who is the head of the French Telegraphs in Tunis, joined the ship at Soussa, to witness the laying operations. We gave in our issue of the 2nd September last some particulars as to the various landing-places of these cables.

THE TELEPHONE CABLE ACROSS THE TAY.—The Dundee Harbour Committee have come to the conclusion that the position of the National Telephone Company's cable across the Tay is objectionable, as it restricts the anchorage ground in the river. This fact is to be reported to the Board of Trade, and a proposal made to have the cable placed as near to the Post-office cables as possible.

THE METROPOLITAN DISTRICT RAILWAY COMPANY AND THE POSTMASTER-GENERAL, IN THE MATTER OF THE ELECTRIC TELEGRAPH ACTS.

(Before Mr. Justice Field and Mr. Justice Stephen.)

This was an application on the part of the Postmaster-General, under the Electric Telegraph Acts, 1868 and 1869, to compel the Metropolitan District Railway Company to allow access to their railway for the purposes of the electric telegraph communication now, under those Acts, vested in the Post-office. The affidavits on which the application was made stated that by those Acts the Postmaster-General had acquired the telegraphs, and among others had acquired the undertaking of every telegraph company with which the Metropolitan Railway Company had any agreement; that at the time the company were the owners of telegraphic apparatus which constituted a complete system of telegraphy in connection with the working of trains and the traffic of the company, and there was no post, wire, or other telegraphic apparatus belonging to any telegraphic company on the company's lines which was necessary for establishing such a system of telegraphy; that the telegraphic apparatus belonging to the company remained the absolute property of the company after the acquisition by the Postmaster-General of the undertakings, under the 9th section of the Act of 1868; and that he became entitled, at his cost, to call upon the company to erect and maintain additional wires; and that he became entitled to a perpetual right of way for his poles and wires over the whole of the system of the railway company; that the question of compensation had been referred to Sir Henry Keating, who, in 1879, awarded to the company the sum of £22,245, which had been paid; and that on the 5th of December, 1881, the Postmaster-General had sent to the general manager of the company a letter enclosing an order upon the company for the erection of a 14-wire cable between Gower Street and Portland Road stations, at the usual rate of £1 per wire per mile for cost of maintenance. The manager replied that the amount of payment must first be settled with the company. The Postmaster-General replied that the company were not entitled to anything above the sum already awarded and paid. This was disputed by the company, who alleged that the Postmaster-General had made payments to other companies for "way leaves" under similar circumstances, but which the Postmaster-General denied. Correspondence continued, resulting in a refusal on the part of the company, and this led to the present application.

The Attorney-General (with him Mr. R. S. Wright) now applied on the part of the Postmaster-General for a *mandamus* to the company to direct them to do and allow what he required. The learned Attorney-General stated the effect of the enactments and of the affidavits, and after hearing him,

The Court granted a rule *nisi*.

TIDINGS OF COMFORT AND JOY.—Some time ago a Reverend gentleman in Glasgow cheered electricians with the encouraging news that they were working out their own salvation as well as that of world at large. The *Bullionist* now comes forward to soothe the troubled breast of the shareholders of the Subsidiary Brush Companies as follows:—"With regard to what comfort holders of patents of the present various systems of electric lighting may take from these encouraging remarks (that certain companies are paying their own expenses), it must be borne in mind that the new invention is yet in its earliest stages, and that their patents may at any time be rendered valueless by the discovery of new and perfected apparatus. It is not an agreeable contingency to have to face, but it is none the less a fact. In all experience regarding the development of great commercial ideas, it has generally been the rule that the pioneers of a special industry have been financially losers. This is, however, an inevitable result of the continued progress of science and civilisation."

INSTITUTION OF CIVIL ENGINEERS OF IRELAND.—At the opening meeting of this institution on Wednesday, the 6th prox., a paper on "Magneto and Dynamo-electric Machines" will be read by Mr. Angelo Fahie, C.E., and will be illustrated by numerous diagrams and some interesting experiments. A number of incandescent electric lamps will be shown in action. In our next issue we hope to give some extracts from this paper.

THE LONDON AND GLOBE TELEPHONE AND MAINTENANCE COMPANY.—This company, having received the necessary licence from the Postmaster-General, are about to begin opening telephonic exchanges in this country. We have also received information to the effect that Mr. José D. Husbands has resigned his position as general manager to the company, so that he may be able to attend to private affairs.

SPECIAL MEETING.—A special meeting of the Mediterranean Telegraph Company is called for to-day, to consider an offer which has been made by the Eastern Telegraph Company to purchase the telegraph lines of the undertaking.

A NEW DEPARTURE.—Mr. Fawcett has nominated a lady as medical officer to the Telegraph Department, General Post-office, London, the reason assigned is that the fair sex is especially represented amongst the officials of that department. *The Lancet* condemns in vigorous language the step and calls upon Mr. Gladstone to overturn the nomination. The clerks, male and female, are said to have sent a petition to the Postmaster-General praying him to cancel the appointment.

WILLIAMS *v.* WESTERN UNION TELEGRAPH COMPANY, HATCH *v.* WESTERN UNION TELEGRAPH COMPANY.—From a New York source we gather, in reference to the above suits, that Mr. Sewell, of Sewell and Pierce, who was the counsel for Messrs. Hatch and Williams, said:—

It will be remembered that in February, 1880, a suit was begun by them to restrain the threatened consolidation. Mr. Gould was building a cable to Europe, and tried to get control of the plans of the Western Union Telegraph Company. He was then principal owner of the American Union Telegraph Company, and by means of cutting rates and other operations he succeeded in depressing the stock of the Western Union until he got it down to such a figure as he considered it would pay him to purchase. About this time Mr. Vanderbilt sold out

his interest in the Western Union and Mr. Gould suddenly proclaimed himself the owner of a majority of that stock. A plan was then formed to consolidate the Western Union, American Union, and Atlantic and Pacific, and to do this the capital stock of the Western Union was increased from 40,000,000 dols. to 80,000,000 dols. Of the increase 15,000,000 dols. were divided among the holders of the Western Union stock. The project was carried out, but Messrs. Williams and Hatch dissented therefrom. They brought suit and obtained an injunction from Judges Spier and Sedgwick, but on trial of the cause before Judge Truax he decided in favour of Mr. Gould and associates. From that decision Messrs. Williams and Hatch appealed, and the appeal was argued in May last before Judges Freedman, Arnoux, and Russell, who now have reversed the decision, and declare the whole scheme of consolidation illegal and void.

On the above subject the New York *Herald*, of the 9th inst., also has the following :—

Western Union was especially weak and sold down to 80. A good deal of the water which was sponged up at the time of the consolidation with the American Union and Atlantic and Pacific lines is beginning to be squeezed out. Not only have the courts decided against the iniquitous consolidation and the issue of some fifteen and a half millions of fictitious and paper certificates, but new enterprises are under way, or are being inaugurated, that promise to start up a formidable opposition. On land the Mutual Union Company is tapping the Western Union Company at all its best paying points, and under sea a new cable will shortly be laid at such cheap rates for construction that the present cables, even under the guarantee of Western Union, will find it difficult to earn a dollar in the shape of dividends. While Western Union is hampered ashore by competing lines, it is also being loaded down by its contract to pay an absurdly high rental upon the cable lines—three of which are moribund, and only one of which is in a condition of life and activity. What between stock water and ocean water Western Union stands a good chance of suffocation, and so most people thought to-day when they either sold out their holdings or went short of the stock, knowing that lower figures must inevitably ensue.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

YORKSHIRE BRUSH ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to September 28th, was filed on October 5th. The nominal capital is £300,000, in £2 shares. 61,633 shares have been taken up and £2 per share called thereupon. The calls paid amount to £122,943 10s., leaving £322 10s. unpaid. Registered office, 326, Mansion House Chambers, 11, Queen Victoria Street.

BRUSH MIDLAND ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to June 30th, was filed on November 23rd. The nominal capital is £250,000, in £5 shares. Of the first issue of 125,000 shares, 25,000 have been taken up. 3,200 are fully paid, upon 800 shares £2 10s. has been called up, and a call of £1 10s. has been made upon the remaining 21,000. The calls paid amount to £31,450 and considered as paid to £18,000, leaving £50 unpaid. Registered office, 31, Lombard Street.

J. B. ROGERS' ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to November 7th, was filed on November 14th. The nominal capital is £510,000, divided into 102,000 shares of £5 each, of which 100,000 are preferred or A shares, and 2,000 deferred or B shares. 3,143 shares have been taken up, and £2 has been called upon the A shares. The total calls paid amount to £5,051, leaving £1,235 unpaid. Registered office, 47, Holborn Viaduct.

NEW PATENTS—1882.

5552. "Voltaic batteries." L. HARTMANN. Dated November 22.

5566. "Exhausting the bulbs of incandescent electric lamps or other articles." N. K. CHERRILL. Dated November 22.

5580. "Certain improvements in the manufacture of carbons, candles, electrodes, &c., for electric lighting and other purposes, and also for other articles, and in the machinery and mechanical arrangements relating thereto for making the same by compression, and in the regulation of the same whether made by hydraulic or other power." W. CUNLIFFE. Dated November 23.

5584. "An improved electric bell." W. R. LAKE. (Communicated by C. F. DE REDON.) Dated November 23.

5586. "Underground conductors for electric currents for lighting." R. J. GÜLCHER. Dated November 23.

5594. "Dynamo-electric machines." C. D. ABEL. (Communicated by B. Abdank-Abakanowicz and C. Roosevelt.) Dated November 24.

5601. "Secondary batteries." A. TRIBE. Dated November 24.

5625. "Improvements in telephonic apparatus, and in materials therefor." J. B. SPENCE and J. E. CHASTER. Dated November 27.

5631. "Dynamo-electric machines." C. A. MCEVOY and J. MATHIESON. Dated November 27.

5633. "Telephonic apparatus." H. H. LAKE. (Communicated by J. H. Rogers.) Dated November 27.

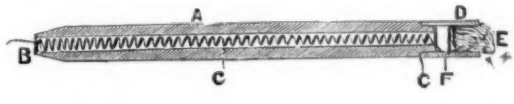
5644. "Secondary batteries or electric accumulators." J. LEA. Dated November 28.

5645. "Primary voltaic batteries." G. G. ANDRÉ. Dated November 28.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

1787. "Dynamo-electric and electro-dynamic machines." B. H. ANTILL. Dated April 14. 2d. According to this invention electric currents are generated by the movement of coils of wire through magnetic fields without change of polarity, or by the movement of magnetic fields of constant polarity relatively to coils of wire. (*Void by reason of the patentee having neglected to file a specification in pursuance of the condition of the letters patent.*)

1822. "Electric lamps." A. S. CHURCH. (A communication from abroad by J. B. King, of America.) Dated April 17. Heretofore in electric arc lamps both solid and tubular carbons or electrodes have been used, but in either case the combustion has been more or less imperfect, and by reason of the ashes or unburned carbon the light has been flickering and unsteady. The objects of the present invention are to keep the carbons clean; to increase the steadiness and brilliancy of the light; to equalise and intensify the combustion of the carbons; and to cause the carbons to last longer than heretofore. In carrying the said invention into practice, the inventor combines, with a hollow carbon or electrode, a piece of moist sponge or similar substance, through which atmospheric air may pass to the arc, and he provides an electric conductor, passing through the carbon or electrode, all as hereinafter described. The figure is a central section of a carbon or electrode, having the sponge suitably attached thereto. A is the carbon or electrode having the central aperture or channel, B, extending longitudinally through it, and C, is a spiral wire within the same, extending the entire length of the said carbon or electrode. In the figure, D, is a tube or cap attached



to the base of the carbon, and containing a piece of sponge, E (or similar substance), which is covered by wire gauze, F. In the cap, D, is an aperture that allows air to enter beneath the sponge, whence it may pass through the sponge to the carbon. The lower end of the spiral wire, C, passes through the hole or aperture in the cap, D, to the outside thereof, and is connected with the source of electricity. In some cases, instead of forming the internal conductor of a spiral wire as shown, it is formed by electro-plating the inner wall of the carbon or electrode. The sponge is to be kept moist. Usually the lamp will be self-supplying in respect of moisture by the chemical union of the hydrogen and oxygen effected by combustion, or by the action of the electric current. The quantity of air passing through the carbon is regulated by the intensity of combustion, and the moist air has the effect of casting off the ashes. By means of the internal conductor terminating at the arc, the inventor is enabled to utilise the electric force more completely than has heretofore been practicable, and thereby to render the light steadier, and to equalise and intensify the combustion of the carbons or electrodes.

1830. "Mechanism for transporting goods and passengers by electricity." FLEEMING JENKIN. Dated April 17. 6d. Has for its object improvements in means and mechanism for conveying goods and passengers from place to place by the aid of electricity. The inventor employs for this purpose strained cables or conductors which serve both to suspend the load and to convey the electrical energy. Wheels are arranged to run along the cable or conductor and the loads hang below, suspended from the axles of the wheels. In the simplest arrangement at each post or support there is a break in the electrical continuity of the cable or conductor and the sections are insulated from each other and from the earth. The sections are, however, coupled together by movable coupling-pieces. An electrical current is maintained throughout the system by a dynamo-electric machine driven by a steam-engine, or in other convenient way. The loads are connected together in trains, and the length of a train is about that of a section of the cable or conductor. A train passing either of the movable coupling-pieces already referred to, moves it and throws it out of action and the current then passes by a conductor on the train itself. The current is conveyed through an electro-motor which drives the wheels and propels the train. The power provided is more than sufficient to maintain a maximum speed, and the train is

provided with a governor which, when the speed is sufficient, closes a shunt and allows the current to pass without traversing the coils of the electro-motor.

1850. "Negativing or destroying the effects of induced currents in telephonic lines." R. D. SMILLIE. Dated April 18. 2d. The invention consists of a pair, or other equal number of pairs, of coils surrounding a central core of iron or wire, applied at each end of a telephonic circuit, the said coils being insulated from each other and from the cores, and arranged so that the inducing currents pass into the coil which immediately surrounds the first core, and from that to the outermost coil of the series of coils surrounding the second core. From the outermost coil of the second core the currents pass back into a second or other intervening coil or coils of the first core, and thence to the line. In connection with this invention, a double line or metallic circuit is employed, and the effect is that the currents induced therein by adjacent telegraph or other telephonic line are brought to react upon each other in the said metallic circuit and are thereby negatived. (*Provisional only.*)

1851. "Insulated supports for the communicating wires of telephones." C. CURTOYS. Dated April 18. 4d. Relates to improvements in the insulated supports which are used for carrying the wires of telephones, and has for its object to provide a support which can be readily and conveniently fixed in its carrier, and to which the wires may be more conveniently and readily connected than hitherto, the said supports being also lighter and cheaper in first cost than are such supports as at present constructed.

1853. "Transmitting and receiving apparatus for printing telegraphs." W. J. BURNSIDE. Dated April 18. 8d. Has for its object improvements in transmitting and receiving apparatus for printing telegraphs. In the receiving instruments of type printing telegraphs, the inventor employs, as in the receiving instruments of other printing telegraphs, a type wheel, to which a step by step revolving motion is imparted, such step by step movements being controlled by a series of electrical pulsations alternately of opposite polarity, which are transmitted from the sending station. The pulsations cause a rapid to and fro vibration between electro-magnets of an armature mounted on an axis, which also carries escapement pallets acting with an escapement wheel on the axis of the type wheel. The axis of the type wheel may either be driven by a train of clockwork, or the revolving motion may be given to the escapement wheel by the to and fro movement of the pallets. In the above respects the apparatus possesses no novelty. The currents are made to pass not only through the coils of the above-mentioned electro-magnets, but also through the coils of another electro-magnet employed to actuate the impression or printing lever. The weight of the lever and armature tends to cause the armature to drop away from the magnet, a spring also tends to draw away the armature. So long as the alternate currents are passing through the coils of the electro-magnet, the armature is not drawn up to the magnet; but so soon as the reversals of the currents cease, and a current of either kind continues for a slightly longer time, the armature in connection with the printing or impression lever is drawn to its magnet, and the pad or platten carried by the lever strikes the paper against the type of the type wheel, which is then opposite to it. In order to be able to set the type wheel to zero the axis of the type wheel has a radial pin standing out from it. A lever arm is held by friction to one of the axes of the train of wheels by which the type wheel is driven. The revolving of the axis tends to carry the lever arm into the path of the radial pin on the axis of the type wheel and stop the type wheel. Each time that the impression lever is impelled towards the type wheel, a claw upon the lever turns the arm away from the type wheel to such a distance that the type wheel is free to make somewhat more than two complete revolutions before the detent can come into the path of the radial pin, so that the type wheel can always be brought to zero if allowed to turn for more than say two complete revolutions without printing.

1862. "Electrical railways or tramways." T. J. HANDFORD. (A communication from abroad by T. A. Edison, of America.) Dated April 18. 8d. Relates to improved means and apparatus for operating or propelling railway or tramway carriages, cars, or vehicles by means of electricity, and to the construction of the carriages, cars, or vehicles, and the arrangements of circuit connections for motors, as well as for track-switches, turn-tables, and other appurtenances, and for the electrical generators. It is the object of one part of this invention to provide simple and efficient means for permitting the gradual retardation or slackening of the speed of a carriage or car for railways or tramways, or a train of such carriages, or cars operated by one or more electro-dynamic motors carried thereby, without depending upon the brakes for this purpose.

2452. "Incandescent electric lamps." J. WETTER. (A communication from abroad by L. Nothomb, of Brussels.) Dated May 24. 6d. Consists essentially in the nature of the carbon filament and of the surrounding atmosphere, in the mode of fixing and in the composition of a cement for connecting the wires to the carbon. The incandescing conductor is formed by animal parchment or cellulose carbonised in an atmosphere carburetted by any suitable means. The cellulose is thus impregnated with carbon. The carbon is fixed to two copper wires by means of a special cement composed of spongy platinum or iron and any organic matter, preferably molasses or sugar, which in carbonising produces a very hard and dense carbon. In order to insure a perfect contact the copper wire is wound several times around the carbon and the connection rendered more solid by cement. The short copper wires terminate at the opposite end in two short platinum wires passing out of the glass globe, and terminating outside with two eyelets, by which the lamp can be hooked to any suitable bracket. In order to increase the resistance of the glass globe against the pressure of the external atmosphere the inventor balances the said pressure by filling the inside with a gas which has no effect on the combustion of the carbon filament, for instance, nitrogen or hydrogen.

2632. "Electric lamps." W. R. LAKE. (A communication from abroad by J. J. Wood, of Brooklyn, New York.) Dated June 5. 6d. Relates to that class of lamps in which the regulating armature carries a vibrating train of wheels which is engaged at the leading pinion with a rack on the carbon-holder, and which has a terminal scape-wheel or detent which is brought up against a stop-tooth when the armature is attracted to separate the carbons, and is withdrawn from the stop when the armature is retracted to allow the top carbon to descend and the gear train to run down to feed the carbons.

2644. "Underground electrical conductors." LIONEL VARICAS. (A communication from abroad by G. Richardson, of Philadelphia, America.) Dated June 6. 10d. Relates to underground electrical conductors, conduits therefor, and ways and means of laying and insulating bare conductors as well as laying previously insulated conductors, and consists in incasing bare electrical conductors with pure hydraulic cement for the purpose of insulating them and protecting them from moisture and corrosion.

2744. "Dynamo-electric machines and electric motors." J. IMRAY. (A communication from abroad by J. J. McTighe and T. J. McTighe, both of America.) Dated June 10. 6d. Relates to the construction of dynamo-electric machines and electric motors, and is designed to improve the method of making and fitting the parts. It consists in improvements—firstly, in the construction of the armature or ring; secondly, in that of the commutator, and finally in the construction and disposition of the field magnet.

2885. "Electric machines." J. A. BEELY. (A communication from abroad by F. V. Maquaire, of Paris.) Dated June 19. 6d. Relates to improvement in dynamo-electric and electro-dynamic machines.

3039. "Galvanic batteries." C. P. NÉZERAUX. Dated June 28. 6d. Has for its object the remedying of certain inconveniences and defects which exist in secondary batteries.

3330. "Electric lighting and power distributing systems." S. PITT. (A communication from abroad by Eli T. Starr and W. J. Peyton, of America.) Dated July 13. 10d. Relates to certain improvements in distributing electricity as a source of power, and for lighting and other purposes.

3443. "Medical battery." W. R. WARREN. (A communication from abroad by G. M. Hopkins, of America.) Dated July 20. 4d. Relates to the class of voltaic batteries employed for curative purposes, and consists of a case containing zinc and copper electrodes, separated by sheets of bibulous paper saturated with an exciting fluid, and a cover fitted to the case, and carrying two contact springs for making connection with the two electrodes, one spring touching the zinc, the other touching the copper, the two springs being clamped to the case cover by bolts passing through holes in the cover, and each provided with two milled nuts, between which the conducting wires or cords are clamped. The invention further consists in electrodes of sheet metal cut in circular form, and each provided with two slits parallel with each other, and located at diametrically opposite edges of the disc, the slits being adapted to receive a flexible band for binding the electrode to any part of the body, or to a sponge to be used for bathing.

3881. "Electric lamps and conductors therefor." F. R. WELLES. (A communication from C. E. Scribner and W. R. Patterson, of America.) Dated August 15. 6d. Has for its object, improvements in regulating the feed of the carbons in electric arc lamps and in the insulation and construction of the electric conductors of the same. For the purpose of controlling the distance between the carbons of an arc lamp an electro-magnet, having its coils in the main circuit, is employed; it operates upon an armature wound with a coil by which the arc is shunted. The armature by connection with a lever, or otherwise, carries a clutch or clutches in which the upper carbon is held. Sometimes two clutches are employed; one in rising takes hold of the upper carbon and lifts it away from the lower carbon; and the other as the armature oscillates propels the upper carbon gradually downwards. The conductors leading from the dynamo-electric machine or other electric source to the lamp or lamps may be contained in a cable. The cable has a central conductor consisting of a cord of fine copper wire, thus surrounded and insulated by jute fibre. Copper wires laid over this form a second conductor on which again there is an insulating layer of jute, and over the jute there is cotton. The whole is contained in a double tube or casing of lead in which steel wires are embedded.

CITY NOTES, REPORTS, MEETINGS, &c.

BRUSH ELECTRIC LIGHT AND POWER COMPANY OF SCOTLAND.

A GENERAL meeting of the above company was held in St. Michael's Chambers, George Yard, Lombard Street, on Tuesday, the 28th instant, the Earl of Crawford and Balcarres presiding. The convening notice having been read,

The Chairman said: Gentlemen, we have met to-day in order to receive a statement from the board as to certain proceedings which have taken place owing to the letter of Sir Charles Bright, and to consider what will be the effect of certain actions brought by some of the shareholders against the company. Perhaps it would not be wrong if I were to say a few words on the origin and history of the company. In 1881 the Anglo-American Brush Electric Company, desiring to extend their business in Scotland, entered into a certain contract to form a small company in Scotland to introduce their system. Later on they desired that Mr. Hope should form a larger

company in order to work the patents on a more extended basis. Mr. Hope duly formed it, calling it the Scottish Brush Company, and he then proceeded to lay the ground for the formation of the present company, of which we are members. When their shares were placed in the market the application for them was very remarkable, for our 20,000 shares we had applications for 373,281. The directors did all they could to make the allotment as just and fair as possible. They spent a large amount of labour on this very difficult and delicate work, and I think they did it conscientiously. The point that I now wish to call attention to is the question of the licences. These licences were handed over by the Anglo-American Brush Company on March 14th to the Scottish Company. The licence of the Brush patents, after rehearsing the considerations, passes on to say, "The Corporation do hereby grant unto the licensees full licence within Scotland, hereinafter called the district, but not elsewhere, to use and authorise others to use, but not to manufacture, dynamo-electric machines and lamps with the invention to which the letters patent refer." Further on in Section 3, "The Corporation will not use or authorise the use by others of dynamo-electric machines or supply others with any other dynamo-electric machines or lamps." This is the licence of the Brush patents. I will now read the licence given with regard to the Lane-Fox patents. After rehearsing as before, it proceeds: "The Corporation do hereby grant unto the licensees full licence within Scotland, hereinafter called the district, but not elsewhere, to use and authorise others to use, but not to manufacture, electric lamps and other apparatus in connection therewith." Further, in Clause 3, "The Corporation will not use or authorise the use by others for the purpose of incandescent lighting or supply others with any such electric lamps for use within the same district." The terms are the same. There are two differences between the licence for the Lane-Fox patent and the Brush. The clauses of the Brush are nine in number. The clauses of the Lane-Fox are 11 in number. The Lane-Fox licence states that the licensees should to the best of their ability push the sale of the said lamps, and should they not push the sale, the licence should *ipso facto* become void. The 11th Clause is that in the event of the licensees finding it necessary to wind-up or go into liquidation either as a company or as individuals, the licence should lapse." That is the entire difference between these two licences. Both are in terms which may be considered exclusive licences. I do not at the present moment wish to go into the whole question. I can only say that the words of the licences were very carefully considered by the gentlemen who drew up our prospectus, in which they only followed those of other companies. In common with these they believed that by the licence granted for the Lane-Fox we had a power of supplying Lane-Fox lamps which nobody else had, consequently our prospectus was issued in all good faith. I thoroughly believe that what was said was correct. Then a short time since—I cannot recollect the date—a letter appeared in the ELECTRICAL REVIEW, signed by Sir Charles Bright, and disclosing to us all that there had been a licence granted to the British Electric Company previous to that which was granted to us, that to that licence there was a covenant as a separate deed which was signed by the British Electric Company, agreeing that they would not in any manner use the name of the Lane-Fox in connection with their business. Therefore the British Company are in possession of a patented method, but they are without the power of using the name of Lane-Fox before the public, and of showing in any way whatever that their position has anything to do with the Lane-Fox. They cannot sell the Lane-Fox as such in Scotland or anywhere else (hear, hear). When I saw this letter, I was rather surprised. I could not help asking myself a question: Why was this not said before? Why has the British Electric Company permitted this false statement that they say we have made to remain unnoticed? I have never tried to give an answer to these questions.

The next question we have to bring before you is to inform you that certain shareholders of the company have taken action against the company, requesting the return of their capital, the amount of money laid out by them in purchasing their shares. Certain questions are raised by the litigation which I may summarise to you shortly. First of all, the question will arise: Is the statement in the prospectus a misstatement of fact? The shareholders will doubtless say, "Yes," as the licence is shown in the prospectus to be exclusive, and as it is shown that there is another licence in existence. For the company we may say that the prospectus is not a misstatement, as the licence is in terms exclusive, and although the British Electric Company have a licence for the process, it cannot sell the Lane-Fox lamp under such a name. It can sell an article consisting of a piece of glass from which the air is exhausted, in which there is a filament of carbon of a certain shape—of the general form which all incandescent lamps assume—the Lane-Fox, the Swan, the Edison—in which the light is produced by the filament becoming white hot under the electric current. The British Electric have a licence for the process, but they cannot sell the result as a Lane-Fox. Assuming, however, that what we have placed before you in the prospectus is a misstatement, the question will arise, Is it a material misstatement, and one which would entitle a shareholder to set aside the prospectus? To this, as a matter of fact, it may be replied that the Lane-Fox patents are no longer of very great value. I do not like to say myself, of my own opinion, whether it is a material misstatement or not. Of course it would be open for a shareholder to say before the judge that at the date of his application for shares it was the statement as to the Lane-Fox lamp which induced him primarily to subscribe, though the Lane-Fox is worth nothing now. If this litigation proceeds, there will be certain effects possible, certain effects probable, certain effects certain to this company. We have to do with an unknown quantity when we come to litigation. We are in presence of the great infinite—(laughter)—and we are unable to say how the carriage of justice will proceed. Very often it appears perfectly certain to both sides that they are in the right, and yet the judge contrives to say that one is in the wrong. The actions may be successful: that is not for us to foretell. There is always this element of uncertainty—but there is a point which is absolutely certain—that this litigation must involve the company in serious expenses in defending itself. It must also hinder us from carrying on the work of the company, because it is impossible to proceed to any extent with a liability hanging over us which cannot be estimated for a considerable period of time. Another point: The Lane-Fox being, as I remarked before, of small commercial value now, the question might be put in this way:—You state that you have a valuable article. But it is valuable no longer. The question would then be, whether, as the shares of the company are not now worth what they were at first, a shareholder could, therefore, demand the return of his money? Assume that the actions are upheld against the company. In all probability we should not recover from the blow; we should have to go into liquidation, and what we consider a really flourishing business would be thrown away (hear, hear). There is, even as it is, the question of litigation which everybody is glad to be out of. What I consider to be as harmful to the company as loss of money by litigation, is the loss of time, and of the opportunity of pushing our system. How can we go over Scotland and take contracts, how could we lay out money while in this position? If the shareholders to-day, after having heard what has been said, should give us the means of feeling that it is our duty, and in their interests to carry on the business of the company, we would feel far more pleasure, knowing that we had the confidence of the shareholders. Although our directors do their best at present, they will then endeavour to do their double best (hear, hear). I forgot to mention that perhaps some of the shareholders would like to know something of what has been done in Scotland. If they will permit me I will call upon Mr. Dickson, who has given very great time, deep consideration, and anxious thought to the matter, as our manager (hear, hear).

Mr. Dickson said that doubtless all present would like to know what they had got for their money, and what they were likely to get in the future, in the shape of purchasers, as regarded the concessions which they had. At the time the company was formed they all thought it would be like the parent Brush Company for Scotland, and when it had gone on a little, and when confidence had been restored, that they might stand in the position of the parent Brush with regard to those thriving industries, particularly in the South and West of Scotland; but when that had been done they put themselves to it and did the best they could. Irrespective of the incandescent light, the great *pièce de résistance* consisted of the Anglo-American dynamo machine, than which a better had not been found for the purposes for which they were using it (hear, hear). The buyer of a share in the company, unless he bought his shares simply to speculate on them, should know what he was buying, and therefore all of them would doubtless know something of the Brush dynamo. He might say that in America at least 95 per cent. of the lights there were wrought on the Brush system for arc lighting. There was nothing in the whole of the researches, and for six months he had been looking as carefully in the matter as he could, that would at all touch that dynamo. No dynamo for arc lighting, and for such purposes as that company contemplates, the lighting of large towns and streets, can at all compare with this machine. With a high tension it could work miles of current. In proceeding with his work he did not go, as it were, broadcast over Scotland. He selected four of the principal towns—the foremost in Scotland—Edinburgh, Glasgow, Dundee, and Aberdeen. He was acquainted generally with the provosts and bailies; and though it was rather up-hill work convincing men of the advantages of the electric light who were, at the same time, gas commissioners, there was one fact looming in front of them which helped him, and that was Mr. Chamberlain and his Act of Parliament. They were forced to do something, and the Brush Company, being in the field, naturally got the orders. They must take the bill and do what they could with it in the public interest. And, therefore, when he put all the facts before them that they were prepared to light their public streets, and that they were not fighting against them, but for them, that their plans, when laid before the Board of Trade to meet their approval, the Darwinian doctrine of the survival of the fittest came in. In many cases he succeeded in obtaining a position for this company. In order to do this—that was, to light the principal streets of the principal towns, they required a large horse-power. It was useless to talk of engines such as the Roby, the Marshall, the Fowler, of 10 or 20 horse-power; they must go bang at it, with a good 500 horse-power, till they had a large supply almost as cheaply as a small one, and could work a large circuit as inexpensively as a short one. Under these conditions they could run gas a pretty sharp turn for it. No other dynamo could run such a current from one single centre, and therefore none could do it so cheaply. Take the case of Greenock. There there were five centres, and that entailed the running of five sets of machinery, different staffs, and all the multitude of things that was comprehended in more than one system. The Brush dynamo did away with all that. In Edinburgh they wrought all their system from one place. They ran a wire alongside the railway, and had their head-quarters some distance out. So also in the case of Dundee, Aberdeen, and Glasgow. He had gone into the matter as economically as possible, and the installations were erected as cheaply as could be done. In Dundee lights were now running that gave the utmost satisfaction to the people. The illumination was so good that the gas was being put out in the shop windows. They were, as he had said, working as cheaply as possible, but he did not believe in doing work for nothing. Some agents could do small orders for a trifle less than their larger dynamos could be profitably worked for. But this state of things would alter. Dynamos were becoming cheaper. At the time when they were in contract for Edinburgh a Brush dynamo cost £750, they could now buy one for £520, and by-and-bye it would be cheaper still. They had reduced their prices 40 per cent., and they were advancing by strides in electrical knowledge; the knowledge of six months ago was the ignorance of to-day. All their capital was intact, and was

earning what would keep the company out of trouble. After these remarks he thought that nothing could be more suicidal and idiotic than to stop their business. They were working as hard as brains could do, and watching progress in the electrical world. Any of them would see what was coming about in the shape of accumulators The lights they had running were in the very best positions in the respective towns. They had not gone away outside, but had taken the very centre and kernel of the cities they were at work in. He believed they had advantages which would tell enormously in their favour.

A Shareholder asked whether they were making any profit out of the corporations that they had selected in Scotland?

Mr. Dickson could only say that they were not doing their work at any loss.

Ashley Ponsonby, Esq. (on the board), said that this letter of Sir Charles Bright had done them a great deal of harm, and put them out of a great deal of work. What they wanted was a decided opinion, one way or the other, whether the shareholders would endorse what they had done, or were satisfied with what they were doing. The action of Sir Charles Bright had paralysed them. Yet they, as men of business, believed that the whole of that letter was simply smoke—it was nonsense. The Lane-Fox licence might not be theirs as a technicality, but as far as the future dividend was concerned, that letter did not interfere with them the snap of a finger. The Brush system of arc lighting was almost perfect—of course improvements would occur—but it was as good as or better than any other system—and far cheaper. The Swan, *e.g.*, was a luxury, and might be employed in shops, and churches, and theatres—but the big dividends came from lighting streets, and factories, and large works. Should improvements be made which would bring incandescent lighting into great prominence; they had the light of the Lane-Fox to make what use of it they liked. Then in the future they could not only get coal cheaper in a good many of their districts, but they could work up water power, which would be doubtless utilised to a far greater extent than now. He had perfect confidence in the future of the company if they put their foot down at once, and said that they would not stand this opposition.

Mr. Cunningham said, with regard to the Lane-Fox lamp, he did not understand whether it was the Anglo-American or the Scottish Brush that had granted the concession to this company. Another thing he would like to know: They had heard that an exclusive right had been granted to use the Lane-Fox; but he had not yet heard whether the company proposed to take any steps to hold that company that had granted the concession responsible or liable in some way or other for damages. He did not quite see the point of the fact, that the British Electric Light Company had a right to use the lamp, though not the name; but perhaps that was not very material. Did the directors intend to lay any claim against the parties who had deceived them in the matter? It was of no importance that the Lane-Fox was of no great utility, they had bought the thing, and they were entitled to have it. The same thing might perhaps be said of the Brush if it should happen to be superseded. The question was, their right, and not its value.

A Shareholder asked if the Hammond Company were competing with them to light up some towns in Scotland?

The Chairman said that they had an exclusive right to the Brush in Scotland. With regard to Mr. Cunningham's question, the term "exclusive licence" was used, though in other cases the word was full. The licence had been granted from the Anglo-American Brush Corporation to the Scottish Brush, that was the company formed by Mr. Hope, and from the latter they had sprung.

The Solicitor to the company said that in legal phraseology an exclusive licence was a licence in which the granter covenants in regard to something that was granted to nobody else. As a matter of fact, when the Lane-Fox licence was given there was another licence then in existence. It was not convenient to discuss whether there was liability on the part of the Anglo-American Brush, or the Scottish Brush; but he would say that this company had made an intimation to the Scottish Brush, that they had certain claims to make upon them with respect to that (hear, hear).

The Chairman said that boards of directors often made arrangements with individual shareholders to move resolutions. He had not done so, but he would be glad if some gentleman would move the resolution which he would read. It ran thus:—"That this meeting, having heard the statements of the chairman, expresses confidence in the board of directors, and requests them to carry on the business of the company, and to oppose all hostile actions brought by shareholders against the company."

Mr. Dalrymple moved the resolution.

Mr. Delmege, in seconding the motion, asked what would be its effect. If the company defended the action, who would have to pay? He would ask why they could not have a test action brought? Could not the seven or eight companies who were threatened with actions combine and bring forward one representative action?

The Solicitor said that the actions brought would presumably be for the return of sharemoney on the ground of misstatement as to the Lane-Fox, but the claim had not yet been formulated. It would, doubtless, be beneficial if a test case could be brought.

A Shareholder said that they had every confidence in the directors, and in Mr. Dickson, who would work anything he was engaged in to the bottom. As to the superiority of the Brush system, he had recently heard from a friend, at present in America, who was interested largely in electric light enterprise, and he said that the Brush there was as 50 to 1 when compared with all other systems (hear, hear). The Yankee was a pretty 'cute fellow, and would not go so largely into the Brush unless there was something in it. He had perfect confidence in the Brush and in their board. As for this litigation, it was a foolish step in the shareholders who began it. He had heard, however, that one company had already obtained on account of the Lane-Fox blunder the sum of £21,000 (no, no. A director: Not a penny!). If our company could get back anything they should too.

Mr. Bullivant would gladly support the resolution just moved and seconded. The question for them as business men was, should the business be carried on, or should they let themselves be bamboozled by a parcel of pettifogging lawyers who were sending their circulars about endeavouring to prejudice the minds of shareholders at an undertaking which they believed would be a most lucrative one, for the sake of getting their paltry fees for winding the company up? should they let their money go into these fellows' pockets? They had got a business which nobody could doubt would be most lucrative, as the electric light would be the light of the future. They had a system with which no other could be compared. The lights of the system in London were all run by a single machine, which they could put in a corner of the room—something like six feet by three—two miles of wire being in the whole circuit, and it had run for 18 months without costing the company more than £5 for repairs. Other systems would have an initial expense that would swamp them if they were to attempt to light the Brush circuit. He had much pleasure in supporting the resolution.

The motion was then put to the meeting and unanimously carried.

On the motion of Mr. Pastow a vote of thanks to the chairman was passed by acclamation, and the proceedings terminated.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).—We learn that this company has received information of the interruption of the cable between Jamaica and Porto Rico, cutting off from telegraphic communication all the company's stations in the West Indies, except Jamaica. The company's ships have been ordered to repair the cable.

QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid	Closing Quotations, Nov. 29.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	9¾-10¼	10¼.9¾.10⅜.¾ ⅜.¼.10.9⅞ac.
		Do. Do.	10	19 - 22	21¼.¼ ac
30,000	5	Australasian Electric Light, Power & Storage Co.	3	1 - 1½	
24,900	10	British Insulite Co., Limited, "A" Shares	5	¼ - 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	¼ - 1	
25,000	5	Great Western Electric Light & Power Co.	2½	¼ - 1¼	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	4¾ - 5¼	5 5/16.¾
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1 - 1	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅝ - ¾	
40,000	5	Pilsen-Joel & General Electric Light Co.	2	1⅛ - 1½	
..	..	South African Brush Electric Light & Power Co.	2½	¼ - 1½	
100,000	5	Swan United Electric Light Co., Limited	2	2 - 2½	2½.7/16 ac.
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	47¾ - 48½	
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until }	100	77 - 78	77 ac.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. }	100	17 - 18	
130,000	10	Brazilian Submarine, Limited	10	11⅛ - 11½	11¼ ac.
16,000	10	Cuba, Limited	10	9½ - 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	7 - 7⅛	7⅛ ac.
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
65,000	20	Direct United States Cable, Limited, 1877	20	11 - 11½	11⅜.7/16
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10½-10⅝	10⅝ m. 10½. 13/16 ac.
70,000	10	Do. 6 per cent. Preference	10	12¾- 13¼	13¼ ac.
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	103 -106	
199,750	19	Eastern Extension, Australasia & China, Limited	10	11¼- 12¼	12 ac.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	108 -111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	105 -108	
140,000	100	Do. do. registered, repayable 1900	100	105 -108	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 -104	
254,300*l.*	100	{ Eastern and South African Limited 5 per cent. } { Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	10 - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6¾- 6¾	6¾.¼
163,209	10	Do. 6 per cent. Preference	10	12¾-12¾	12¾ m. 12¾ .13/16 ac.
125,000	10	Great Northern	10	12¼- 12½	12½ ac.
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	28½- 29½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	30 - 31	
38,148	10	London Platino-Brazilian, Limited	10	4 - 4¼	
12,000	10	Mediterranean Extension, Limited	10	1¾- 2	
8,200	10	Do. 8 per cent. Preference	10	6 - 8	
9,000	8	Reuter's, Limited	8	12¾- 13	
280,000	Stk.	Submarine	100	245 -255	
58,225	1	Do. Scrip	1	2¼- 2⅜	2⅜ m.
4,200	Cert.	Submarine Cables Trust	100	103 -107	
37,350	12	Telegraph Construction and Maintenance	12	32 - 33	32 ac.
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅜- 1⅝	1⅜ m.
30,000	10	West Coast of America, Limited	10	5 - 5½	
150,000	100	Do. 8 per cent. Debentures	..	.. ..	
69,910	20	Western and Brazilian, Limited	20	7⅛ .. 7⅜	7⅛ ac.
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	95 - 99	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building)Bds.	$1,000	121 -124	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1¼- 1⅜	
34,563	10	Do. 6 per cent. 1st Preference	10	7 - 7⅛	7 ac.
4,669	10	Do. 6 do. 2nd do.	10	5¼- 6¼	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1 - 1⅛	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	⅜ - ⅞	
100,000	5	United Telephone Co.	5	10¾- 11¼	